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PRODUCT ENGINEERING

NOVEMBER
1935

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FOURTH ANNUAL DESIGN SURVEY

Never have developments in the design of machinery and products been so numerous and striking, evidencing great engineering skill. But of greater significance, they signalize that another era of momentous material developments has already begun

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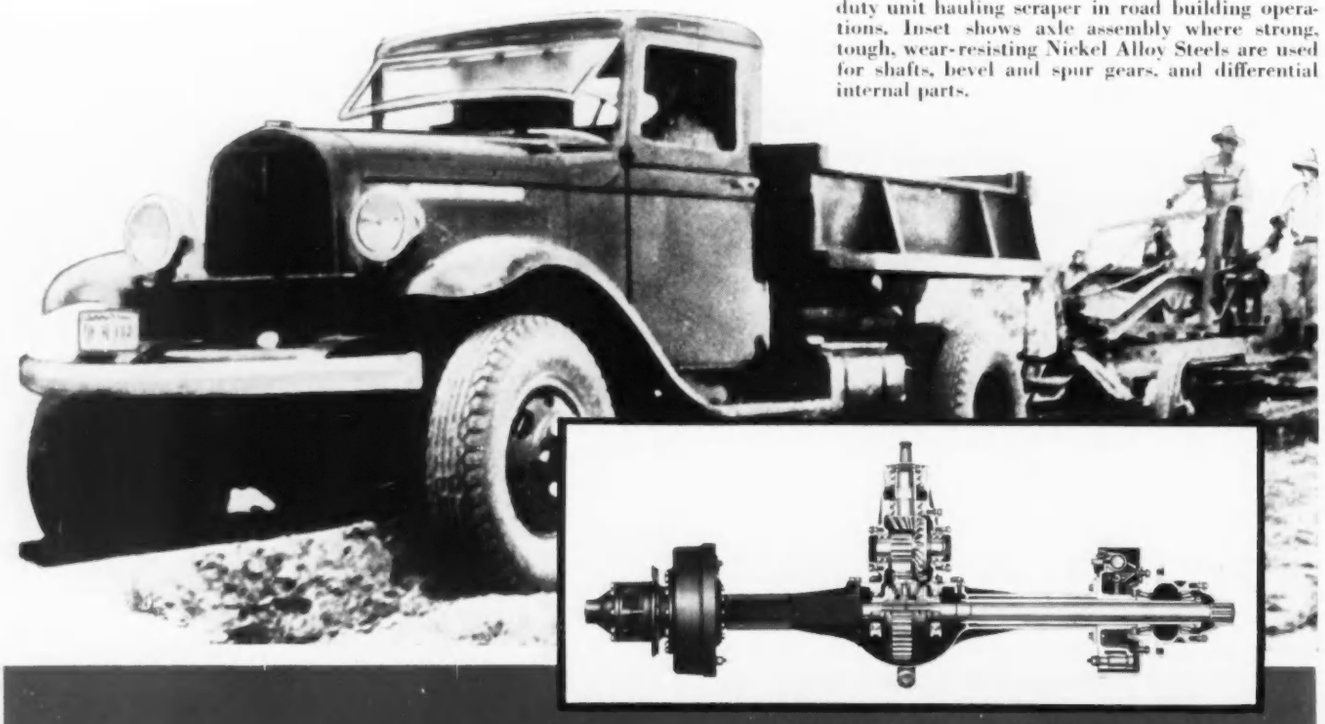
Mechanical Design • Product Development

McGRAW-HILL PUBLISHING COMPANY, INC.

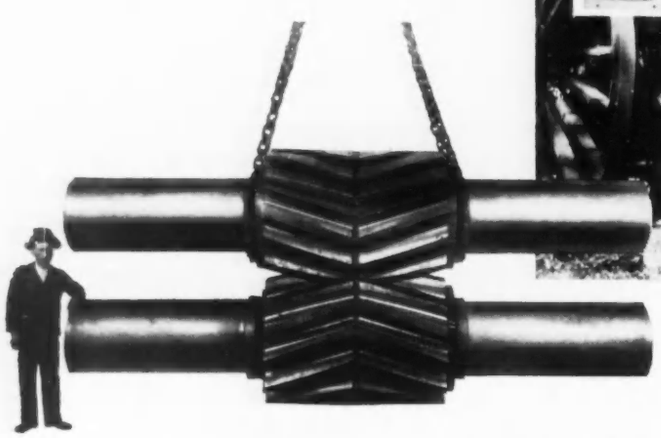
Truck turns tractor. Marmon-Herrington heavy duty unit hauling scraper in road building operations. Inset shows axle assembly where strong, tough, wear-resisting Nickel Alloy Steels are used for shafts, bevel and spur gears, and differential internal parts.

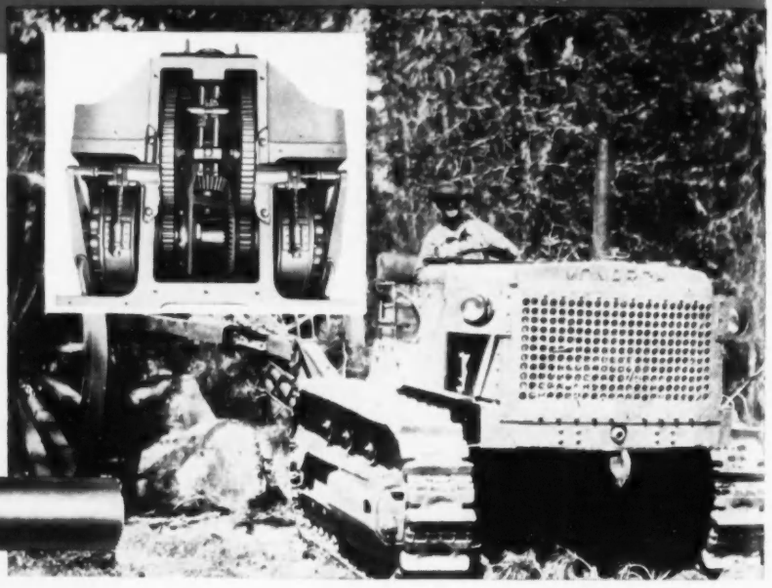


NICKEL

Reduces Breakage and Wear in Metal-to-Metal Contacts

None of your "blooming" business requires sturdier materials than pinions. This pair, weighing 80,000 pounds, are made of Nickel Chromium Steel to give greater resistance to stress and wear. Installed in blooming mill of Pittsburgh Crucible Steel Company.





Tough as a tank, this timber towboat. An Allis Chalmers Monarch "75" logging in Oregon. Inset shows transmission assembly. All gears of Nickel Alloy Steels—selected for this punishing service because of superior toughness and high resistance to stresses and wear.

FREE! Send for our handy celluloid vest pocket size "Hardness Conversion Table." Quickly gives approximate relation between Brinell, Rockwell and Shore hardness values and corresponding strengths of Nickel Alloy Steels. Address Dept. J-5.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

PRODUCT ENGINEERING

VOLUME 6 NUMBER 11

MASON BRITTON, *Vice-President*

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Coming Issues

December *P.E.* will present the fifth of the series of articles by Howard Ketcham, entitled "Color Illusions." You may not be an artist but you certainly will be interested in this article.

Then to finish up the year with a good array, there will be an analytical article by Hans Schemm showing the extent to which the center distance of a given pair of gears may be modified without resorting to special cutters.

Other articles will include one on the method of determining the diameters of clearance holes and center distance tolerances—an article by Carl P. Nachod on the construction of radial charts—the second article of the symposium on bearing metals—and of course the usual departments.

In January *P.E.* we begin a series by M. G. Van Voorhis on the construction of nomographic charts. These articles will tell how to make them, and prove the construction.

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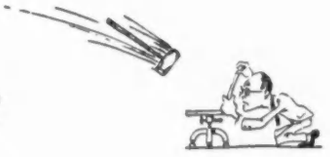
Intimate Correspondence



In deference to the expressed wishes of some of our readers, letters published on this page will give only the initials of the writers unless specific permission is given to use the name.

Three of 86

PRODUCT ENGINEERING
NEW YORK

I would very much appreciate your sending me a reprint of the two articles on mechanical motions which were published in the June and July 1930 numbers of *Product Engineering*.

Allow me to say that I look forward to each new issue of your magazine with genuine eagerness. —A.J.G.
Burbank, Calif.

PRODUCT ENGINEERING
NEW YORK

I noticed that you offered to send a reprint of "Pictures of Working Models of Mechanical Motions" as long as they last. I would greatly appreciate this leaflet.

May I also take this opportunity to congratulate you on publishing an outstanding magazine. It certainly keeps one informed about the latest developments in all fields. —F.K.K.
Dundalk, Md.

PRODUCT ENGINEERING
NEW YORK

On reviewing the October issue of *Product Engineering*, I was very much pleased to notice in the Intimate Correspondence section, a letter from R.H.S.H. regarding mechanical movements.

Would you please send to me the four-page pamphlet reprint if there are any copies available?

Would you kindly give me the address of the American Standards Association? I would like to obtain their publication on Drawing and Drafting Room Standards. Could you also advise me the price of the publication? —C.H.Y.
Toronto, Canada

FRANKLY, we were taken by surprise. The requests for these reprints are still coming in and we are just about run out of copies.

As to the American Standards Association, the address is 29 West 39th Street, New York, N. Y., and the price of the Drawing and Drafting Room Standards is 50 cents.

Something on Stampings

PRODUCT ENGINEERING
NEW YORK

Because much of the eye appeal being put into products is done with sheet metal, I think it would be in order for you to run some articles pertaining to sheet metal design. Deep drawings such as automobile fenders and body parts would be of interest. In your past articles relating to stampings, only small parts were covered. —J.P.C.
Peoria, Ill.

WE are always open for suggestions and would like to hear from other reders as to their ideas as to what should be covered in an article on large stampings.

Filing Engineering Data

PRODUCT ENGINEERING
NEW YORK

On page 2 of the October number, reference is made to filing systems for engineering data. For many years I have used the Dewey decimal system for all kinds of engineering data. It has the advantage that no bit of information can be found for which there is not a place. I use the Breckenridge and Goodenough "Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries," University of Illinois Bulletin No. 9, and also, for radio subjects, the Bureau of Standards Circular No. 138, "A Decimal Classification of Radio Subjects—An Extension of the Dewey System." For communication engineering I made a simple expansion in the realm of telephony, which accommodates all that I need.

On this matter, I welcome further discussion because filing is as broad and complicated as engineering itself. —A.B.S.
Chicago, Ill.

A SOLUTION to most filing problems can be found in the references given by A.B.S., but as he states, the subject is as broad and complicated as engineering itself. Undoubtedly, many other readers will also welcome further discussion of this subject.

Standardization Demanded

PRODUCT ENGINEERING
NEW YORK

Referring to your Intimate Correspondence article "Let's Start Something" in the October number:

This subject is of particular interest to the writer who handles purchasing and engineering and has one whale of a time trying to file catalogs which vary from vest pocket editions to city directory sizes.

We have a very great need for a filing system and will certainly give our wholehearted support to the standardization of technical and advertisng printed matter. The indexing of same, while being of importance to the writer, is secondary to the size question. —C.D.S.
Detroit, Mich.

HERE is a real worthwhile job for the American Standards Association. And if enough users of catalogs demand it, the association will undoubtedly do something about it. It's a case of the wheel that squeaks the loudest gets the grease.

Hardware Hard to Get

PRODUCT ENGINEERING
NEW YORK

Thank you for your letter with reference to metal cabinet hardware, door holders, and similar items. We have decided to make our own hardware after giving this matter some consideration. —H.E.C.
Philadelphia

PRODUCT ENGINEERING
NEW YORK

One of the hardest things for me to find is modern, trim, neat designs of hardware such as box catches, locks, hinges and handles. It seems difficult to find manufacturers who have catered to fittings suitable for metal boxes. Trunk makers have their hardware from fiber and wood construction, but there seems to be few who offer such things for metal work.

I am wondering if other designers haven't run up against the same problems. Perhaps this might even be worthy of a short article, since fittings so often can make or mar the whole design scheme. —G.J.W.
Detroit, Mich.

WE agree with the above writer that one of the hardest things to find is a list of manufacturers of hardware suitable for metal cabinets and boxes. We have the names of a few of these in our files, but for the most part they seem to succeed pretty well in keeping their existence unknown to designing engineers. We will appreciate receiving a few more addresses of such manufacturers with a brief statement of the types of hardware they offer.

PRODUCT ENGINEERING
NEW YORK

We were much interested in the article you published in the October issue of *Product Engineering* dealing with resistance welding.

In connection with this, we would greatly appreciate any literature reference you could give us wherein is discussed the basic principles involved in resistance welding and in welding with atomic hydrogen. —H.W.P.
Freeport, Ill.

ATOMIC hydrogen welding is a development of the General Electric Company and they will be glad to furnish you with data. "Types of Resistance Welds and How They Are Used," *P.E.* May 1934, will give you information on resistance welding. Thomson-Gibb Electric Welding Company of Lynn, Mass. will be glad to furnish engineering data

PRODUCT ENGINEERING

GEORGE F. NORDENHOLT, *Editor*

MCGRAW-HILL PUBLISHING CO., INC. NOVEMBER 1935 VOLUME SIX, NUMBER ELEVEN

Give Them Credit

NEW production machinery amazing in its performance, streamlined trains, bigger and more luxurious airliners, new home equipment and automobiles that put former models to shame—such is the unmatched record of products developed over the past year. But why all this sudden activity? Why these numerous expositions that attract tens of thousands of people and cause wonder and amazement? The worst business depression in history is scarcely over. Its effects are still felt. Yet the greatest parade of new products that the world has ever seen is in full swing.

During the depression while some were busy hanging crepe on the portals of the future, there were others who bent their efforts to creative tasks. To the laymen, politicians and bankers, they were forgotten men. Only scientists and engineers watched closely the new developments that slowly, but in steady stream, issued from the workshops of scientists. No blare of trumpets or flowery orations announced these new discoveries. Many of them had little or no immediate commercial value. Their potential values were beyond the comprehension of the non-technically minded.

Chemists compounded new materials; metallurgists developed new alloys and heat-treatments; scientists evolved new theories. New plastics, elastic non-shatterable safety glass, oil-resisting rubber-like compounds, electronic devices and automatic controls—these are a few of the things born during the depression. While crooked bankers were dodging jails and politicians were jockeying to placate opposing factions, while brain trusters and economists were solemnly discoursing on weighty problems of finance, while blue eagles and other alphabet administrations were hopelessly trying to substitute mandates for natural laws—scientists and research workers were slowly grinding out the ingredients for a new prosperity.

What the designing engineers have done already with the new tools and materials furnished by science marks but the beginning. Old industries are being expanded to new frontiers; new industries are coming into existence. The limit cannot be predicted; there probably is none. Scientific and technical growth cannot be stopped until man reverts to an unthinking animal.

POLITICIANS will fill the air with claims and counter claims for the credit of ending the depression. New deals, the blue eagle now dead, the wasteful slaughter of millions of pigs, the plowing under of acres of cotton and grain and the myriad other makeshifts to alleviate a bad situation at the expense of the future, will each be lauded as the country's salvation or condemned as blunders. But in the final analysis business is the result of a demand for goods and products. Business can grow only as more new and better products are created and machines are developed to make them at costs within the reach of the masses.

To the scientists and the product engineers who created the new materials and processes, conceived the amazing robots of production and developed the products that have obsoleted the old, belongs much of the credit for licking the depression.

The 1935 Survey of

CHANGES AND TRENDS

A summary based on data and information furnished by 500 executive engineers, setting forth recent and contemplated changes in product design with reference to types of construction, materials and finishes

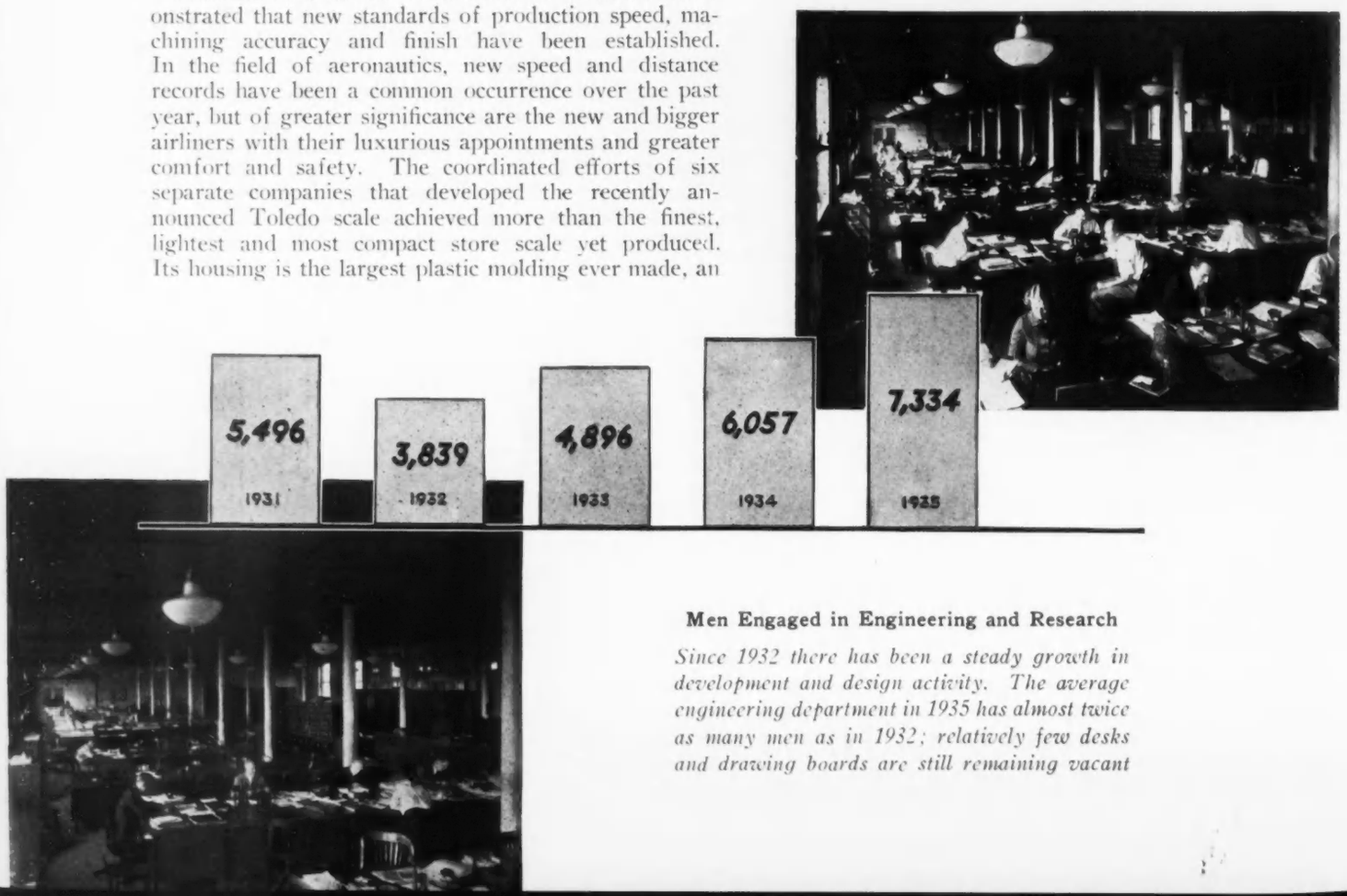
•

ENGINEERED products put on the market during the past year can be described only in superlatives. Fastest, finest appearing, biggest, most accurate—such are the features by which marketability has been obtained in the 1935 creations of designing engineers.

Machine tools at the recent show in Cleveland demonstrated that new standards of production speed, machining accuracy and finish have been established. In the field of aeronautics, new speed and distance records have been a common occurrence over the past year, but of greater significance are the new and bigger airliners with their luxurious appointments and greater comfort and safety. The coordinated efforts of six separate companies that developed the recently announced Toledo scale achieved more than the finest, lightest and most compact store scale yet produced. Its housing is the largest plastic molding ever made, an accomplishment that required the designing of a new press, the biggest of its kind. Thus, plastic molded parts much larger than heretofore are now obtainable.

In transportation and allied fields, the much publicized streamlined trains of stainless steel and aluminum tell only a part of the story. Diesel engines of lighter weight, new types of welded construction, oil-resisting rubber, low-alloy and high-strength steels and flexible glass are only a few of the items that have contributed to the recent developments in railroad equipment.

New construction equipment and machinery put on the market during the past year reflect the steady trend towards more powerful units of greater capacity, more flexible and rapid in operation and easier to maintain.



Men Engaged in Engineering and Research

Since 1932 there has been a steady growth in development and design activity. The average engineering department in 1935 has almost twice as many men as in 1932; relatively few desks and drawing boards are still remaining vacant

IN PRODUCT DESIGN

Achievements of engineering skill that have obsoleted the old machinery of construction, production and transportation, and that have outmoded the consumer products of all previous years
INGERSOLL

New products for the home are familiar to all, as are the robots of business—machines that perform operations far beyond human capabilities.

To make possible all these new developments required greater engineering activity, a fact borne out by this survey. Compared with 1934, the average increase in the number of engineers employed, as reported by 368 companies, is 21 per cent. The number of engineers, draftsmen and research workers in these 368 companies totals 6,057 for 1934, and 7,334 in 1935. Taken by fields of manufacture, the increase ranges from 1 per cent for 11 manufacturers of textile machinery to 51 per cent for 67 machine tool builders.

For this fourth annual survey, factual data on design trends have been obtained from more than 465 filled-in questionnaires contributed by engineering executives. After discarding those questionnaires that were incomplete or evidently inaccurate there remained 425 acceptable questionnaires. In addition, much significant information was received in the form of letters from responsible engineers.

But letters and questionnaires alone cannot give a complete picture of the current changes and trends in product design. Designing engineers were interviewed, plants were visited, expositions were attended by the editors of *Product Engineering*, and editors of other McGraw-Hill publications were consulted.

In requesting information for this survey, it was stressed that only the engineering features that represented changes or trends were to be indicated. This

has special reference to types of construction, materials, unit parts and finishes being adopted. It was the aim of the questionnaire to determine the trend with reference to recent adoptions, the further extended use or the contemplated adoption of the various parts and materials specified by designers. In some instances the items checked on the questionnaire indicated that they had been in use over a long period, and this data therefore was not included in the tabulations given on the following pages.

Almost every improvement in the design of an engineered product requires or involves the use of a new or better material, the incorporation of a new device or the adoption of new driving or control units. For this reason it was considered that at least mention should be made of such developments. Nearly 500 leading manufacturers of parts, materials and finishes were invited to outline briefly the significant developments in their products over the past year. The information thus obtained is briefly summarized in this report. Space limitation does not permit a complete presentation and only the most significant developments are included. But in each instance enough information is given to enable those interested to investigate further.

▼ ▼ ▼

Steel with a pedigree begins its career. Pouring an electric furnace heat at the Sivyer Steel Castings Company

Machine Tool Designers Stress Hydraulic Drives and Electrification

Pronounced trend to sealed bearings, oil filtering and central lubrication. Higher speeds tend to more use of aluminum to decrease inertia effects. Built-in lighting gaining rapidly.

OF THE 67 companies reported in this group, 59 are machine tool builders, 3 are manufacturers of portable tools and 5 are accessory manufacturers. The number of engineers, draftsmen and research workers employed by 50 of these companies increased from 578 in 1934 to 873 in 1935. On the basis of figures submitted, this will increase to 1,056 in 1936, indicating that the 51 per cent increase during 1935 is not a mere temporary spurt. Several chief engineers reported a scarcity of experienced designers in their particular field. The increased number of engineers employed is reflected in the 135 new or redesigned machines announced during the past year by 67 manufacturers, averaging two machines per company.

For greater marketability, 78 per cent of the machine tool builders reported special attention being paid to form and finish, a trend much in evidence at the Cleveland Machine Tool Show. For improved appearance, compactness and smooth surfaces, the trend is toward flush-mounted, pushbutton stations. Cast aluminum cover plates, artistically fluted, hide the electrical wiring in the Gray planer; sheet metal covers with neat handles of cast aluminum give the New Britain Gridley screw machine a unified and neat appearance. Kearney & Trecker carry out a modernistic effect in the design of the louvres for their motor compartments. Cast-in stripes, grooves and ribs are being used to accentuate dimensional proportions. Sweeping surfaces with unbroken smoothness bespeak the trend to modernistic appearance, partly explaining why more than 73 per cent of these machine tool manufacturers report the more extensive use of hollow-head screws. Among other reasons given are: absence of screw heads jutting out makes it easier to keep the machines clean; fewer knuckles are skinned; and more convenient wrenches for the maintenance man.

Standard machine tool gray is still firmly entrenched, but 23 per cent of the chief engineers are specifying lacquer finish, primarily for appearance and greater durability. Thirty per cent of the engineers state that they are paying more attention to nameplates; a few are now in color. Several engineers are using cast white metal for dials; some use zinc etched plates. In either case, the raised lettering is polished and the background is dark.

Welded construction is much in evidence, 19 per cent reporting a more extended use of it. The application of flame-cutting to heavy sections of rolled plate, and the accuracy obtainable through the use of pantographs, radiographs, and similar devices used for flame-cutting has made feasible and economical the substitution of irregularly shaped flame-cut pieces for cast members. Machine beds, uprights and large frames are now commonly of welded design, as in the shears and press brake designed by the Cincinnati Shaper Company. Ingersoll Milling Machine Company's new milling and boring machine is almost entirely of welded construction. It weighs more than 128,000 lb. Inserted semicircular cast-iron ways in the bed accommodate the tubular table slides.

Many chief engineers report using welded construction for special machines or where only a few machines of a given design are to be made.

Chilled cast iron is still prevalent for wear-resistance, but the trend is to the use of hardened steel, Nitralloy, hard-facing materials, and chromium plating. Slides and ways on lathes and special machines are, in many instances, of hardened steel, fastened on by screws. Thus attached, they are replaceable. One lathe manufacturer nitrides the ways.

Increased use of Nitralloy is reported by 20 per cent of these manufacturers; 18 per cent report more use of hard-facing materials, 22 per cent are using more chromium plating for wear resistance. Lathe dead centers tipped with Carboloy are reported to increase the accuracy and decrease the wear, with life between truings multiplied as much as 24 times. Another application of Carboloy is for inserts on work rests on lathes and centerless grinders which, according to reports, lasted 360 times longer than hardened steel rests.

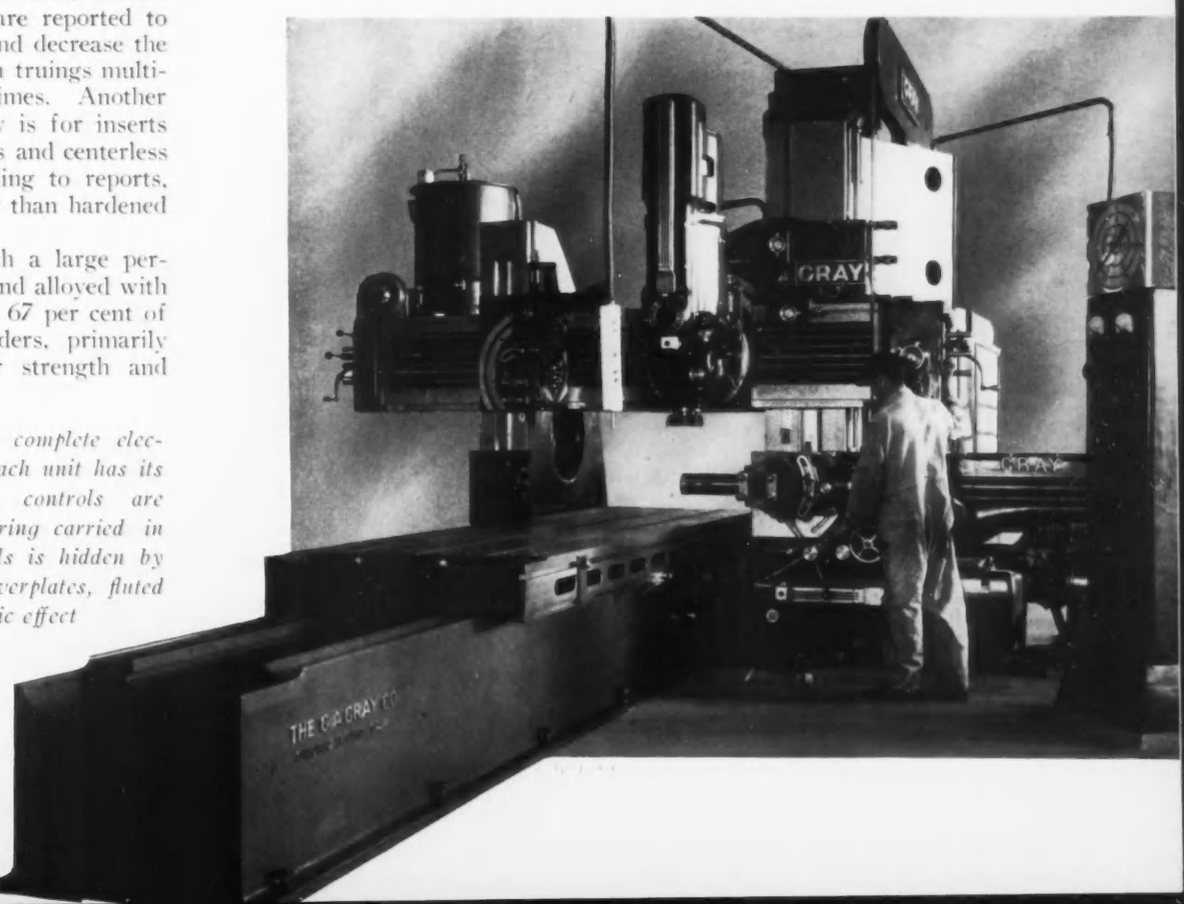
Cast iron mixed with a large percentage of steel scrap and alloyed with nickel is being used by 67 per cent of the machine tool builders, primarily because of its greater strength and wear resistance; also because of the cleaner and closer grained castings obtained and the absence of blow holes.

Relative to materials of construction, various chief engineers comment: "Using more flame-cut plates" . . . . "We use both low and high alloy steel" . . . . "Higher speeds and heavier feeds require better materials."

Higher speed of operation is resulting in more attention to weight, primarily to reduce inertia effects. More than 35 per cent of these engineers are extending the use of aluminum alloys; four companies are now using magnesium alloys, several are contemplating doing so. In every instance the purpose is to permit quicker stopping and starting of rotating members or to permit faster reciprocation. One shaper has a cast aluminum ram. One gear shaper uses an aluminum alloy connecting rod to drive the ram.

With reference to drives, transmissions and controls, 61 per cent of these designing engineers are using more hydraulic operating units; 47 per cent are extending the use of multi-motoring; 14 designers have gone in for geared motors, while 19 of them are going in for variable-speed drives. At the Cleveland show, nine manufacturers exhibited various machines equipped with the New Departure Transitorq variable-speed drive. Similarly, more than 50 manufacturers had machines equipped with hydraulic operating units for various purposes. Vickers, Inc., showed a variable-speed, hydraulic transmission consisting of pump and hydraulic motor, with the pump directly driven by an electric motor.

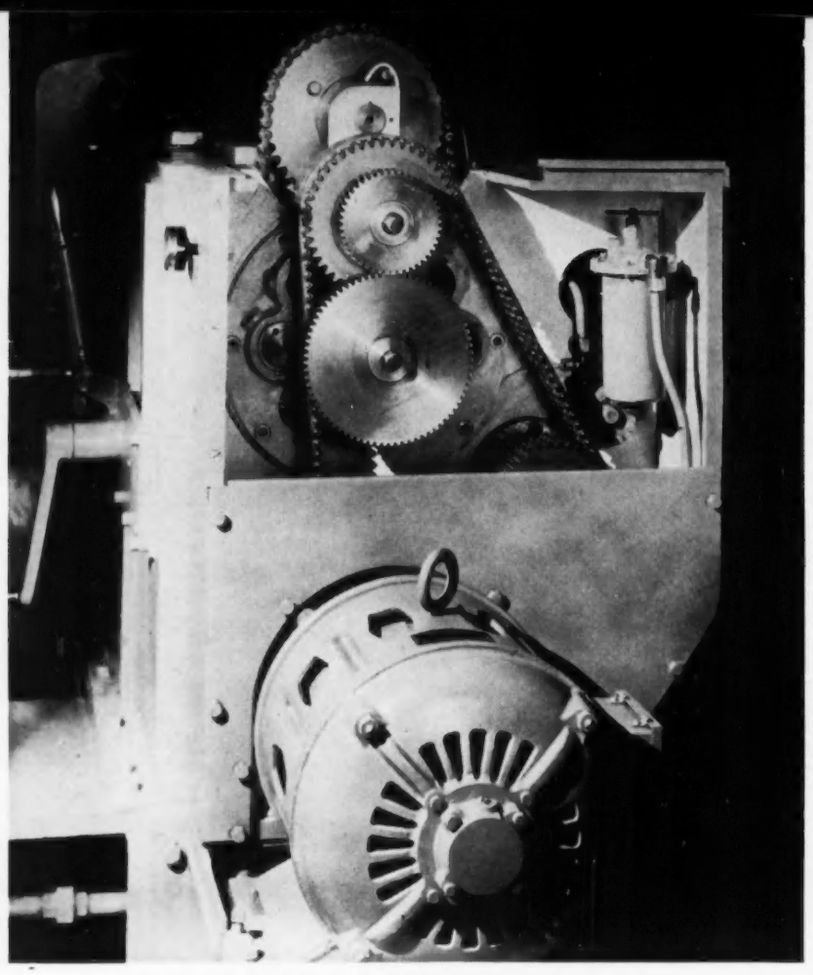
More use of single and multiple V-belt drives is reported by 61 per cent of the companies in this group. Some engineers state that the reasons for such choice are primarily the smoothness of the drive and freedom of work chatter. Considerable impetus has been given



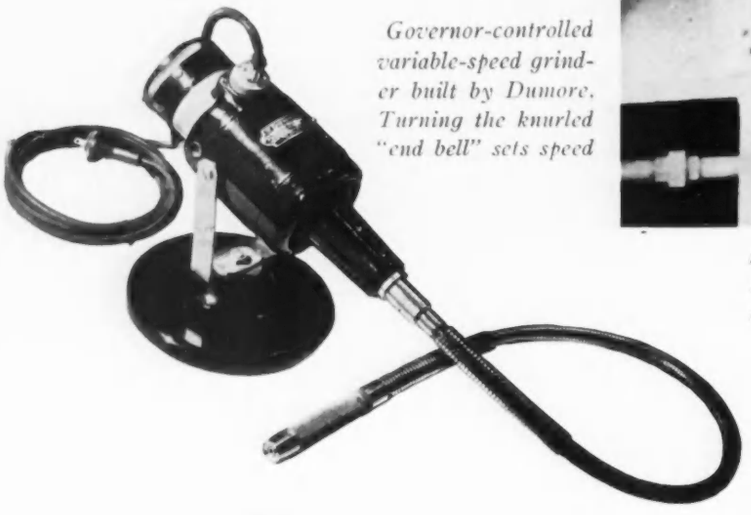
Exemplifying complete electrification. Each unit has its own motor, controls are grouped. Wiring carried in cored channels is hidden by aluminum coverplates, fluted for modernistic effect

to consideration of this type of drive by the development of oil-proof V-belts made of synthetic rubber-resin compounds recently developed. These belts are claimed to have a normal length of life even under severe conditions where they become saturated with oil.

Much attention is being given to electrical control devices. Magnetic controls are receiving further attention by 54 per cent of the engineers, and the use of limit switches is being extended by 56 per cent of the companies in this group. Other significant items include the extended or contemplated use of electrically operated valves by 18 engineers, electronic controls and thermostatic devices by 9 engineers, and 20 designers paying more attention to the application of indicating instruments.



Both silent and roller chains are used in this New Britain-Gridley screw machine. Lubricating system includes pump, filter and pressure gage



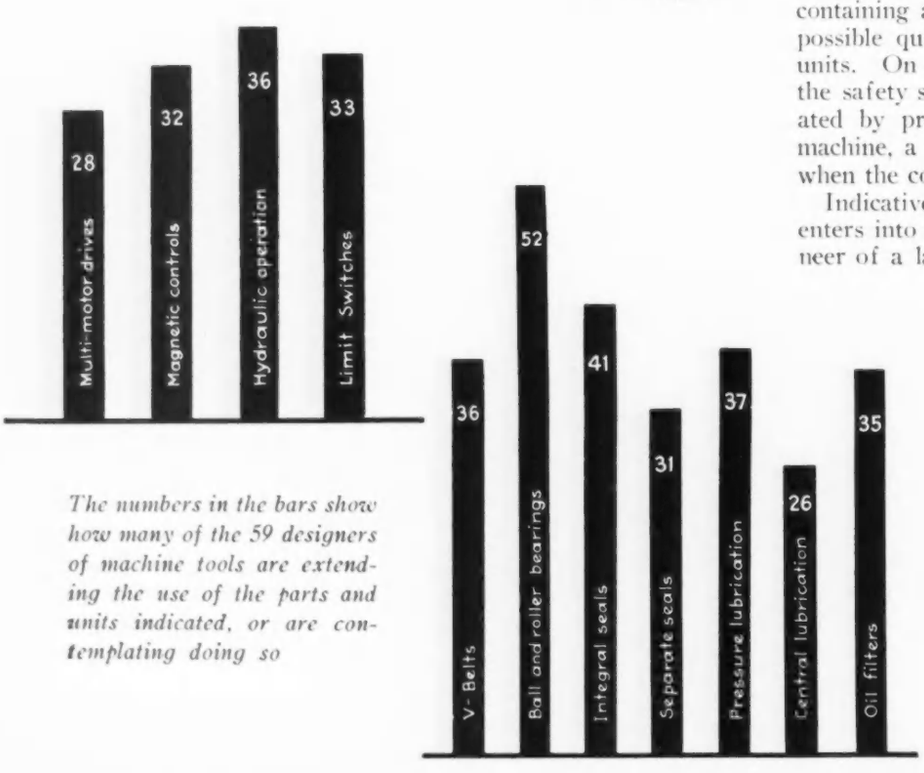
Governor-controlled variable-speed grinder built by Dumore. Turning the knurled "end bell" sets speed

A great deal of attention is being given to the centralizing of the electric controls by means of pendant switches as used on planers. Centralized control panels containing all of the electric pushbutton stations make possible quicker manipulation of the various machine units. On quite a number of the new machine tools, the safety switch button or pendant lever can be operated by pressure in any direction. On one milling machine, a safety switch disconnects the electric drive when the cover of the change gear box is opened.

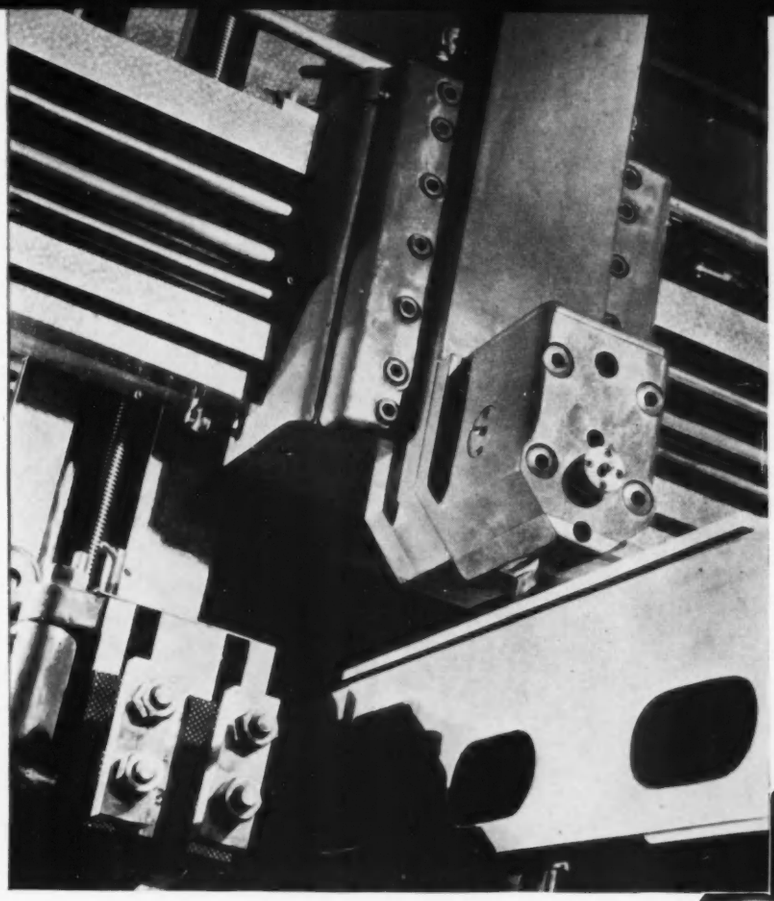
Indicative of the extent to which electrical operation enters into the design of machine tools, the chief engineer of a large machine tool manufacturer stated that he employs an electrical engineer to supervise the design of the controls and that recently it was necessary to give this engineer an assistant.

One interesting development is that the electrical wiring is now being pre-assembled, all of the wires being cut to the correct length and connected. This "harness" is then simply laid into the proper channels or ducts and the connection made to the different terminals. This makes it unnecessary to cut any wires to length and tediously fit and connect them individually.

Lubrication and the sealing of bearings is receiving a great deal of attention. With 88 per cent of the



The numbers in the bars show how many of the 59 designers of machine tools are extending the use of the parts and units indicated, or are contemplating doing so



Cutting on both the forward and return stroke, a feature of the Sellers planer. Note spacing of the hollow-head screws

designers extending the use of anti-friction bearings. 70 per cent of them are going in for integral sealed anti-friction bearings. Designers report that sealed anti-friction bearings are used primarily where space restrictions do not permit separate seals. More than 52 per cent are extending the use of separate commercial sealing units, while four engineers report that they have recently gone into the use of such units for application to sleeve-type bearings.

Pressure lubrication is reported by 63 per cent of these engineers, while 44 per cent report a more extensive use of central lubricators. Pressure lubrication of ways and slides is more in evidence than heretofore. When movement of the carriage exposes the oil holes, they are automatically stopped by the action of oil pressure or springs against ball plugs. A plunger type pump on the cross slide is usually used to furnish the lubricant for the slide and bed ways.

The more extensive use of hydraulic operation and pressure lubrication undoubtedly accounts for the numerous new applications of oil filters as reported by 59 per cent of the machine tool designers. These developments also account for the extended use of flexible tubing as reported by 36 per cent of the designers in this group.

One of the problems introduced by central lubrication and hydraulic operation has been the transmission of the fluid to moving elements. The B. F. Goodrich Company reports improvements in the development of oil-resisting hose. They also offer a hose for high pressure service which is rated to withstand an internal pressure of 20,000 lb. per sq.in. Where particularly sharp bends must be made and maximum flexibility must be provided, oil-proof rubber hose seems to have preference over flexible metal hose. On the other hand, flexible metal hose or tubing is preferred over ordinary rigid tubing for the oil piping. It is easier to install, not requiring bending operations, and avoids stress concentration at joints and points of support.

Self-tapping screws are coming into more general use as indicated by 25 per cent of these engineers. Such screws are being used generally for attaching nameplates and dials.

One of the striking trends is the extending use of built-in lighting, as reported by 29 per cent of these manufacturers. One of the engineers interviewed stated that built-in lighting was offered by his company as optional equipment, but whenever the machine was shipped without the built-in lighting unit the customer requested that it be supplied. This new development, still in its early stages, is gaining rapidly. Its sales advantages, strikingly demonstrated in the design of home equipment, are being recognized rapidly among machine tool designers.

Shakeproof Lock Washer Company

Self-tapping screws, a popular method for attaching nameplates

Noise isolation and decreased operating noise is receiving the attention of 67 per cent of the designers. The greater use of rubber mountings is reported by 11 engineers; the further use of cork is reported by 7 of them. One engineer stated they were now investigating the possibilities of machine sub-bases fitted with suitable cushioning material to prevent floor vibrations from being transmitted to the machine. In his experience, it was found that the user of the machine could not be depended on to properly mount the machine to avoid vibrations being transmitted from the floor and

affecting the work being produced by the machine. This same engineer emphasized that more attention should be given to avoiding vibrations by good design and dynamic balance, rather than merely trying to isolate them.

Comments contributed by various chief engineers of machine tools include: "We are investigating metal spraying. . . . We are changing over to hollow-head screws entirely. . . . Experimenting with integral sealed ball bearings. . . . Duprene is now being used for diaphragms and motor pads. We are using sensitive relays to show up dull tools or overloads. . . . Using more flame-cut plates. . . . We aim to eliminate sources of vibration through better balance and keeping resonance speed and operating speed from coinciding. . . . Concentrating on excellence in hydraulic operation to attain amazing ease of control and smooth operation. . . . We have done away with belt drives in favor of direct drive with flange mounted motor. . . . Higher speeds and heavier feeds require better materials, hence we use both low and high-alloy steels. . . . Using pneumatic operation on our new machine. . . . Copper plating is used on sliding surfaces for better lubrication and wearing surfaces. . . . Our new development is automatic lubrication throughout the whole machine."

▼ ▼ ▼

Printing—Textile and Other Manufacturing Machinery

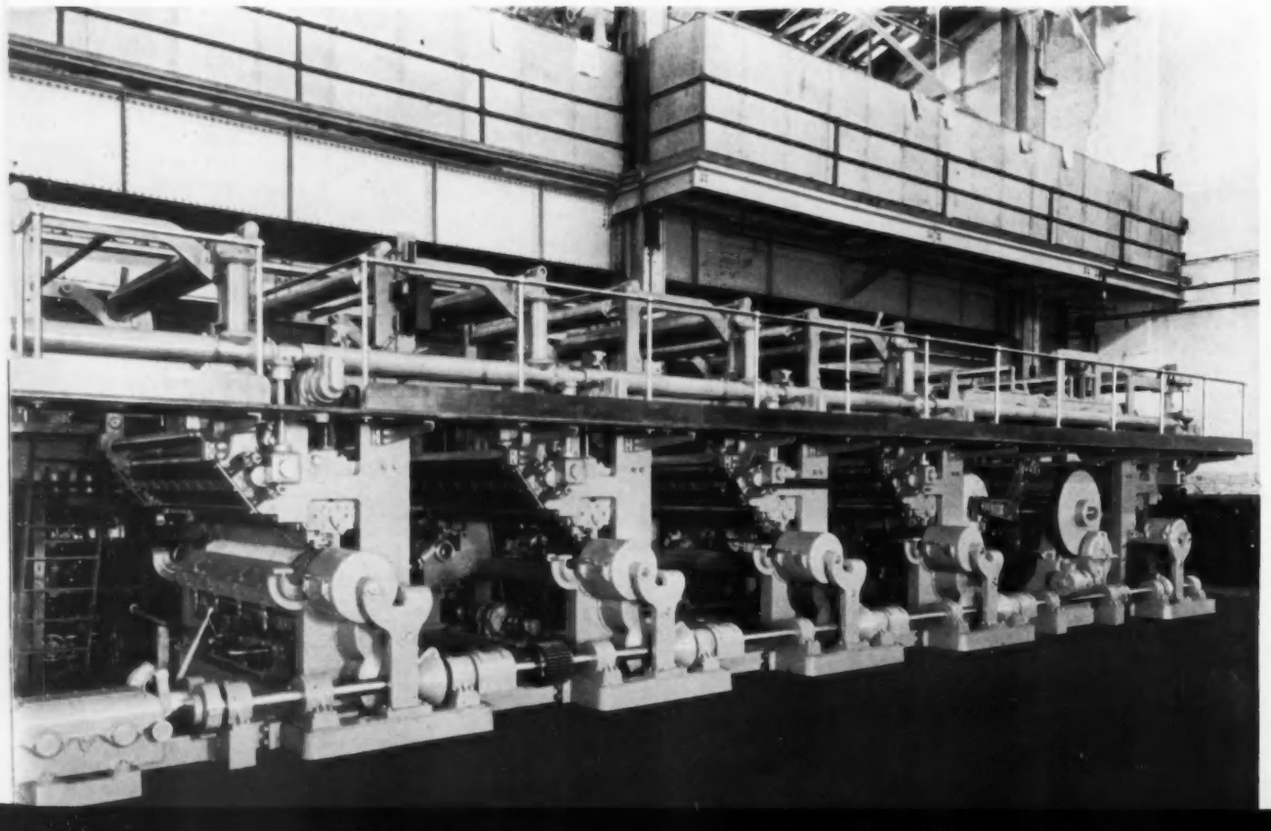
New developments include hydraulic motor drives for printing presses and governor-controlled electric motors. Higher speeds compel more attention to bearings, lubrication and oil filters.

IN THIS group of 64 companies from which questionnaires were received, 12 manufacturers of textile machinery reported an increase of 1 per cent in the number of engineers employed, 10 printing press manufacturers reported a 50 per cent increase, 25 manufacturers of non-metal working machinery reported a 23 per cent increase, and 17 manufacturers of conveyors and shop cranes reported an increase of 29 per cent. The total for all companies was 638 engineers employed in 1934 and 812 in 1935, an increase of 27 per cent.

These 64 companies reported 99 new or redesigned machines; 8 of them reported complete redesign of their whole line.

With reference to general design trends, increased speed is the aim of 90 per cent of the manufacturers of textile and printing machinery; 65 per cent of them also indicating more attention to controls and efficiency of

In the design of printing presses the trend is to more anti-friction bearings and central lubrication. In the foreground can be seen the Link-Belt P.I.V. transmission for this modern Hoe magazine press



Showering sparks and blinding light—the phenomenon of arc welding. Because it is an economical process, permits simplified design and less weight, 43 per cent of the designers of textile machinery, printing presses and non-metal working machinery are extending the use of fusion welding; nearly the same number are adopting resistance welding for the same reasons

Lincoln Electric Company

Modern Alloys in Production Equipment

Per cent of companies making greater use of some of the newest types of alloys

Type of Equipment	TEXTILE	PRINTING	PROCESSING	CONVEYING
Number of Companies	12	10	25	17
Stainless Steel.....	67 per cent	40 per cent	68 per cent	35 per cent
Alloy Steels.....	50 " "	80 " "	48 " "	100 " "
Alloy Cast Iron.....	67 " "	70 " "	48 " "	47 " "
Aluminum Alloys.....	50 " "	40 " "	37 " "	41 " "

operation. In the design of printing presses, 70 per cent of the engineers reported more emphasis being placed on appearance and noise reduction.

The percentages of the companies in this group that reported the contemplated or extended use of the parts and units indicated, are as follows: anti-friction bearings, 75 per cent; sealed anti-friction bearings, 55 per cent; unit bearing seals, 40 per cent; oilless bearings, 44 per cent; hollow-head screws, 56 per cent; and pressure lubrication, 36 per cent. Central lubrication is being extended by 14 of these engineers and 9 are making further use of oil filters.

In the accompanying chart is shown the per cent of companies that are extending the use of the types of power units and transmissions indicated. Sixteen of these engineers are extending the use of fiber gears and 13 are seeking noise reduction through resilient motor mountings.

In the design of a machine used for dressing grindstones used to pulverize paint pigments, three Dumore governor-controlled, universal-type motors are used for driving the feeds. Two motors feed the cutting wheel carriage across the sides of the stone being dressed; the third drives the rotating table feed. Governor-controlled, universal motors permit a wide range of speeds without loss of power from rheostats.

Universal motors with centrifugal governor to cut

off the power supply when a set speed has been reached, have been in use for a number of years for driving calculating machines. Inquiries among machine tool designers indicate that this type of motor is being considered for certain feeds.

Reflecting the trend toward increased speed and improved controls, 45 per cent of these machinery manufacturers are extending the use of limit switches and 53 per cent are making more use of magnetic controls. More applications of electrically operated valves is reported by 15, electronic controls by 9, and thermostatic devices by 7 of these engineers.

Built-in lighting is being adopted by 6 of these manufacturers and 25 per cent are improving their product by adding timers, counters, recording and indicating instruments.

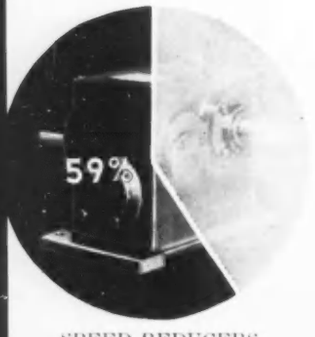
Hydraulic operation is now being contemplated or applied by 9 of these manufacturers. One striking development is hydraulic drives for printing presses. Higher press speeds require the use of quick-drying, highly-volatile inks, which create an explosion and fire hazard. Remotely located, an electrically-driven, variable-displacement pump delivers oil to hydraulic motors at the press. The hydraulic drive eliminates the possibility of explosions or fires as might be caused by electric sparks.

Spinning frame equipped with a Reeves drive which automatically reduces r.p.m. as the yarn builds up on bobbin, thereby holding drawing speed constant

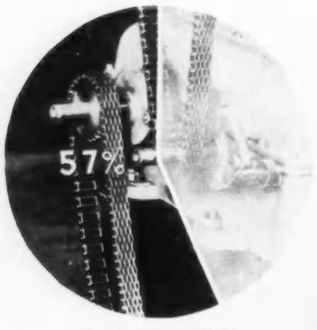
Another striking drive is a variable-speed, positive-type transmission which is used in the Autopaster for newspaper printing presses. Automatic control of the transmission ratio synchronizes the surface speed of the new roll of paper with that of the paper coming off the emptying roll and going through the press. Pushing a button automatically pastes the end of the new roll onto the sheet coming off the now practically empty roll. The remnant of the latter sheet is cut off from its roll and the paper on the new roll goes through the press, being threaded through by the piece to which it had been pasted. So quick is the whole operation that it cannot be followed by the eye. There is no slowing down or stopping of the press when starting a new roll of paper; the production at the rate of 55,000 copies per hour continues undiminished.

Main trends in this group with reference to materials of construction is

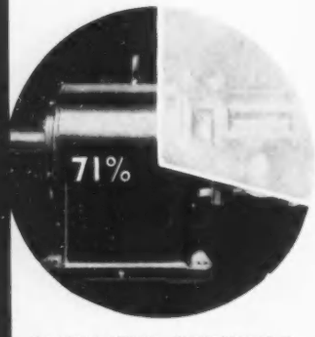
TYPES OF TRANSMISSION UNITS THAT ARE RECEIVING ATTENTION



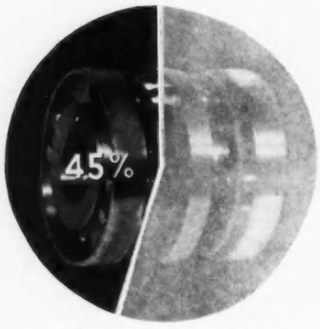
SPEED REDUCERS



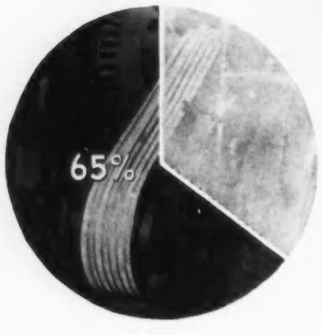
CHAIN DRIVES



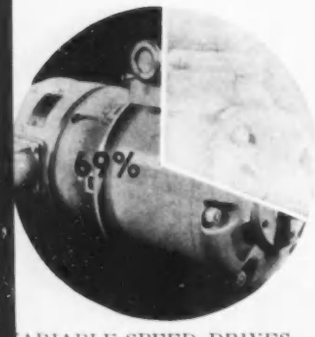
MOTORIZED REDUCERS



FLEXIBLE COUPLINGS



V-BELTS



ARIABLE-SPEED DRIVES

Six types of power transmission to which designers of printing and textile machinery and non-metal working machinery are paying special attention. The percentages are the proportion of manufacturers that reported new or contemplated applications of the part shown

shown in the accompanying table. With reference to type of construction, fusion welding is being extended by 43 per cent of these designers, resistance welding by 38 per cent. Of the textile machinery builders, 41 per cent are favoring stampings and an equal number are going in for the greater use of molded plastics. Rubber for noise isolation is finding a more extended use, as reported by 30 per cent of these manufacturers.

In the design of printing presses where speeds have been stepped up considerably over the past few years, aluminum alloys are coming into quite general use in order to keep down inertia forces. One designer of printing presses reports the use of magnesium alloy castings for weight reduction.

Designers in this group are using more lacquer finish, as reported by 43 per cent of them. An almost equal number report more use of chromium plating and nameplates.

▼ ▼ ▼

Steam and Diesel Equipment Using More Corrosion-Resisting Materials

Pumps, compressors, valves, turbines and air-conditioning units making greater use of stainless steel, alloy cast iron, monel metal, hard facing and plating to reduce corrosion and wear

PUMPS, compressors, valves, blowers, furnaces, boilers, power plants, refrigerating equipment and air-conditioning apparatus are included in this group of 53 reporting companies. Their design activity is indicated by an increase of 14 per cent in the number of engineers, draftsmen and research workers employed in 1935 as compared with 1934. Of the 9 valve manufacturers represented in this group, 7 are extending the use of stainless steel for its corrosion resistance, 3 are using more Monel. For wear resistance, 5 are using Nitralloy and hard-facing materials.

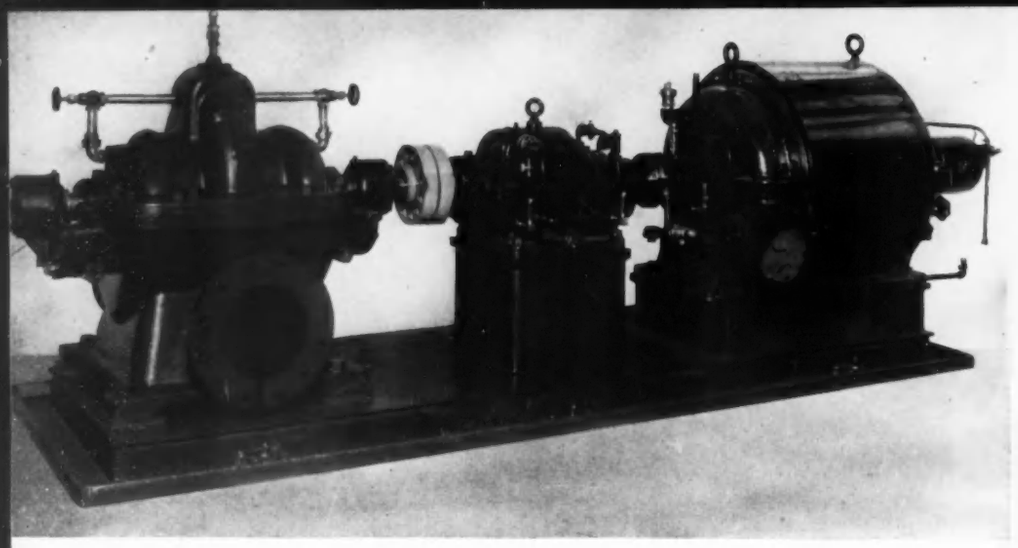
One design of valve has its seat faced with Stellite to withstand wear, erosion and high temperatures up to 800 deg. F. A new line of hydraulic valves has stems and seats tipped with Carboloy. For services where less corrosive liquids are to be handled, nickel cast iron is also being used. Hancock valves use stainless steel disks and seat rings hardened to 500 Brinell. Another line of valves uses molded plastic handwheels in color with raised lettering to identify the service, such as hot, cold, steam, gas.

Of 20 manufacturers of pumps, compressors and engines, 17 are extending the use of anti-friction bearings with 7 of them going in for integral sealed anti-friction bearings while 10 are extending the use of separate unit seals. Also, 7 are now extending the use of oilless bearings; 40 per cent are going in for central lubrication, while 30 per cent are equipping their machines with oil filters.

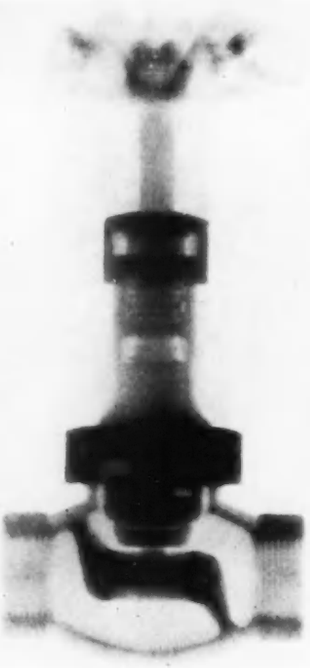
Conforming to the expressed aim of 60 per cent of

Westinghouse Electric & Manufacturing Company

What happens to turbine blades when subjected to erosion, corrosion and high temperature in the low pressure stages



Welded construction, anti-friction bearings, alloy steels and alloy cast iron are features of this Cameron centrifugal pump with turbine drive through reduction gears



Examinations by X-rays and gamma rays show condition of the internal structure. This gamma ray (radium) photograph is of the new Hancock valve with seat and disk of hardened stainless steel

the pump and compressor manufacturers for improved form and appearance, 35 per cent are extending the use of holiow-head screws. Thermostatic controls to indicate overheating, electric valves and limit switches are receiving the attention of five of these manufacturers.

With reference to power drives and transmissions, the accompanying chart gives the percentage of the manufacturers in this group that have recently adopted or are extending the use of the units indicated. Similarly, the principal materials which are being adopted by these 20 manufacturers, and the major reasons for their adoption are shown here graphically.

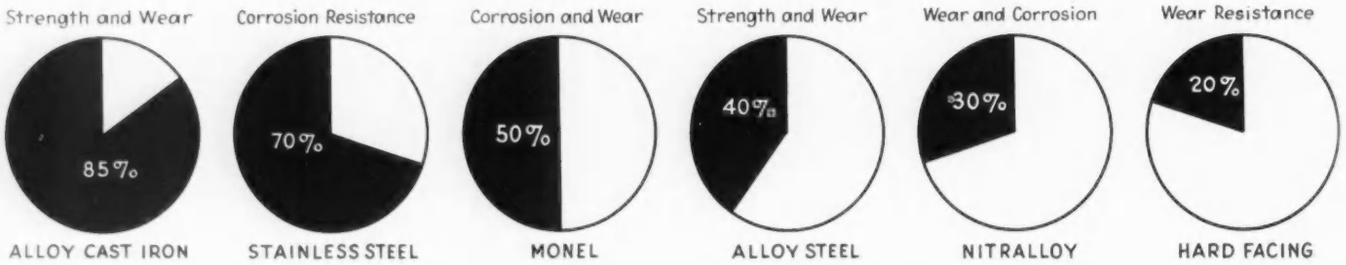
One manufacturer reports the use of Chromel heat-resisting castings for the combustion chambers of diesel engines where high temperatures create a difficult problem. This material is also used for nozzles and baffle plates in gas burners.

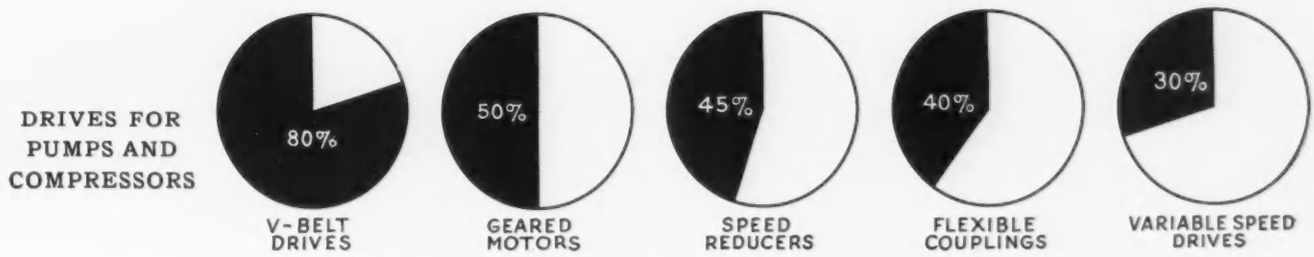
The new Calorizing process by which an iron-aluminum alloy is formed on the surface of steel, is finding further applications, especially for oil refineries, power plant equipment and heat-treating furnaces. In this new process, a layer of iron-aluminum alloy is formed on the surface, containing 50 to 75 per cent of aluminum and to a depth of 0.005 to 0.010 in. deep. Subsequent heat-treating in a closed retort causes a penetration of this iron-aluminum alloy into the steel to a depth of about 0.04 in. Surface layer is high in aluminum concentration which diminishes at increasing depth of penetration, there being no line of demarcation between the iron-aluminum alloy and the parent metal. Surface is somewhat porous and brittle, but the underlying layers, containing the lower percentage of aluminum, are relatively ductile and close grained, giving this coating its resistance to corrosion at elevated temperatures.

Cracking still tubes of 5.00 Cr steel with 0.50 Mo to reduce the temper embrittlement tendency, have been Calorized by this new process and found highly resistant to oxidation and sulphur corrosion. Hard aluminum-iron surface makes them extremely resistant to erosion. According to tests, this coating is resistant to oxidation up to about 1,650 deg. F. In addition to cracking still tubes, it is also used for valves, pipe fittings, burner tips and grate bars.

Important developments have taken place during the past years in synthetic rubber-like materials. Thiokol is an oil-proof synthetic rubber that is finding numerous uses where oil resistance is required. This material is also abrasion-resistant and is said to be flexible even at temperatures as low as —45 deg. F., and to withstand

How 20 manufacturers of pumps and compressors reported on recent or contemplated adoptions of high-strength, corrosion and wear-resistant materials





The charts indicate the percentage of companies that are extending the use of the type of drive indicated, as reported by 20 manufacturers of pumps and compressors

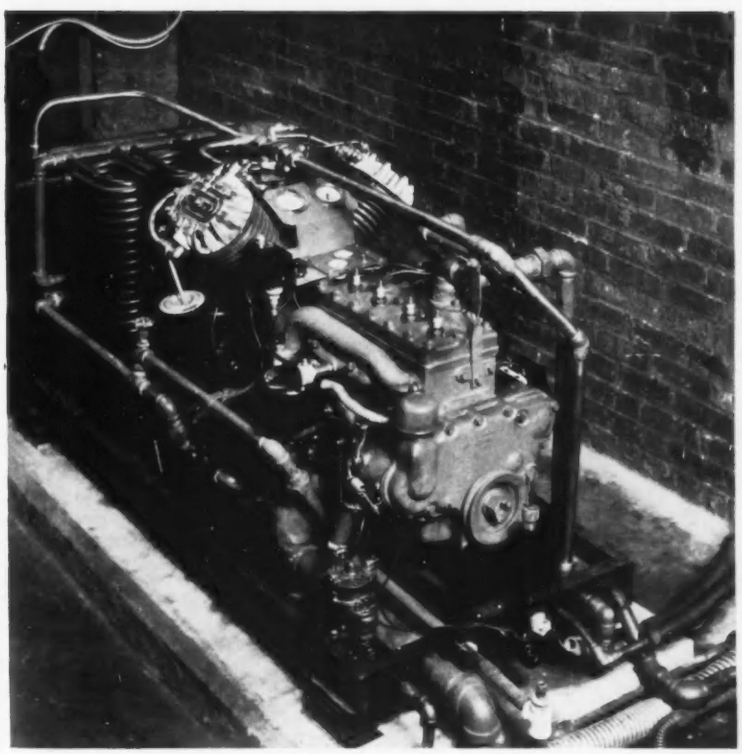
temperatures of 200 deg. F. Another form of Thiokol is available in the liquid form and can be brushed, sprayed, dipped or spread on. It is applied to cloth and leather as a protective coating. Thiokol is also used for lining rubber hose for oil resistance, valves, and similar parts.

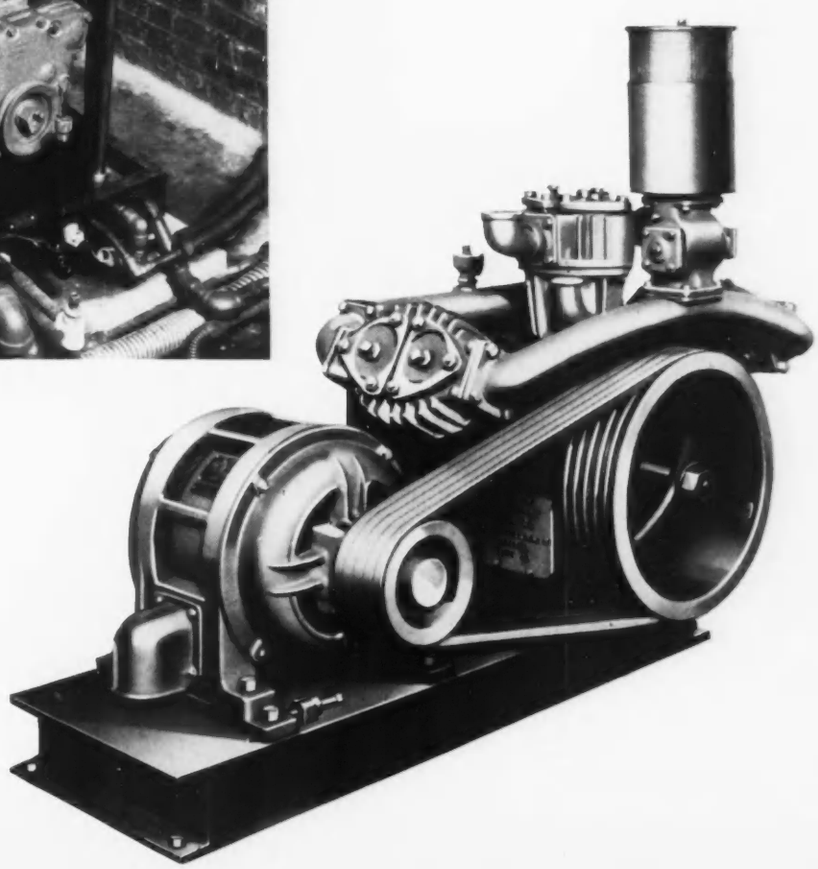
Another synthetic rubber-like material is Koroseal, also resistant to oil and strong corrosives. It has found applications for gaskets or sealing members working in oil, tubing for transferring chlorine gas, ozone and sulphur chloride, flexible sleeves working in grease. It is also claimed resistant to sulphuric acid and concentrated nitric acid.

Centrifugal castings of aluminum bronze are now available up to 2,000 lb. each, diameters up to 40 in., and up to 96 in. in length. Heat-treated, they are obtainable in various compositions for a wide range of specific services. They have been used for gears, heavy bearings, wear plates, pump liners and similar applications. Gas valves with centrifugally cast Ampco aluminum bronze liners, reamed to a mirror-finish, are reported to have less leakage and double the wear life of ordinary sand cast valves.

Nickel cast iron is also used for gas engine driven compressors for cylinders, liners, heads and pistons. A refinement is chromium and molybdenum added to the nickel cast iron, reflecting further development of these complex cast iron alloys.

Another special composition widely used in the petroleum industry and trade-named Ni-Resist contains 14 per cent nickel, 6 per cent phosphorous and 2 to





For quietness, this Waukesha air-conditioning unit is supplied with a soundproof cabinet (not shown) that fits over the whole unit. Rubber hose pipe connections and rubber pads also isolate the noise. In the Ingersoll-Rand compressor (to the right) tapered roller bearings permitted a shorter, and hence more rigid, crankshaft

3 per cent chromium. Hardness ranges between 140 to 200 Brinell as cast; wear and corrosion resistance is high. It is finding considerable application for valves, pumps and compressor bodies.

Welded plate construction is rapidly increasing, being used extensively for pump bases, engine crankcases, and pressure vessels. Much development work in this direction has been the result of researches by contract welding shops, as well as in the laboratories of some of the progressive manufacturers.

Diesel engine crankcases and bedplates and both fired and unfired pressure vessels, are examples in this field. Such welded structures are usually stress-relieved by furnace annealing after all welding has been completed. Gamma or X-ray inspection is coming into more general use.

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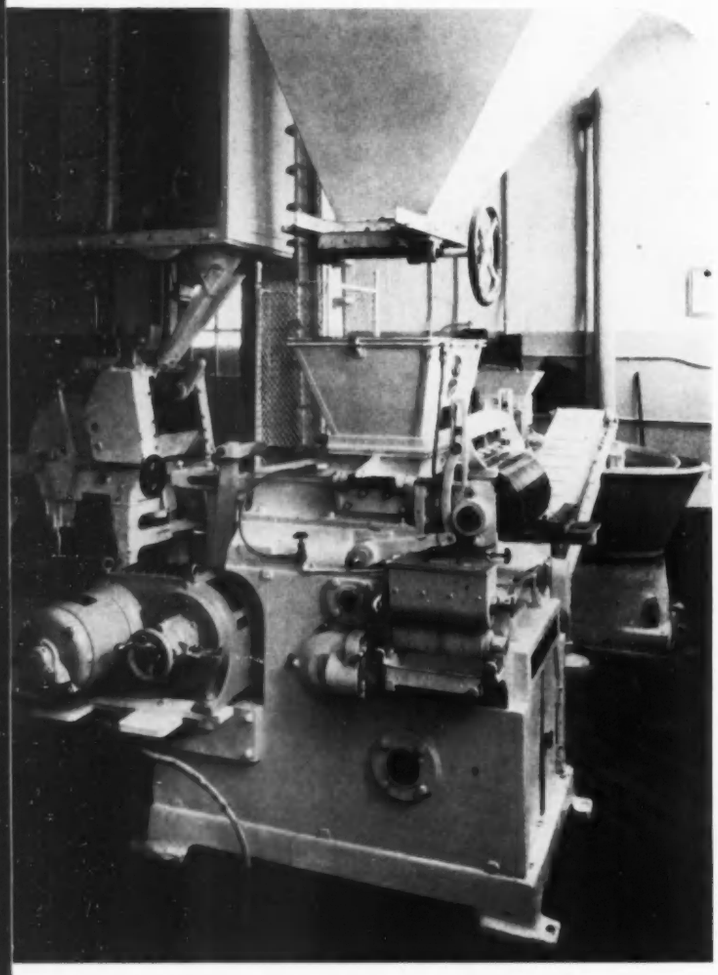


Correct dividing speed depends on size and density of the dough batch. The built-in U. S. Varidrive makes the right speed quickly available

Food and Packaging Machinery Using More Variable-Speed Drives

Ever-present problems of corrosion and sanitary requirements cause more extended use of stainless steel, oil-seals and electroplating.

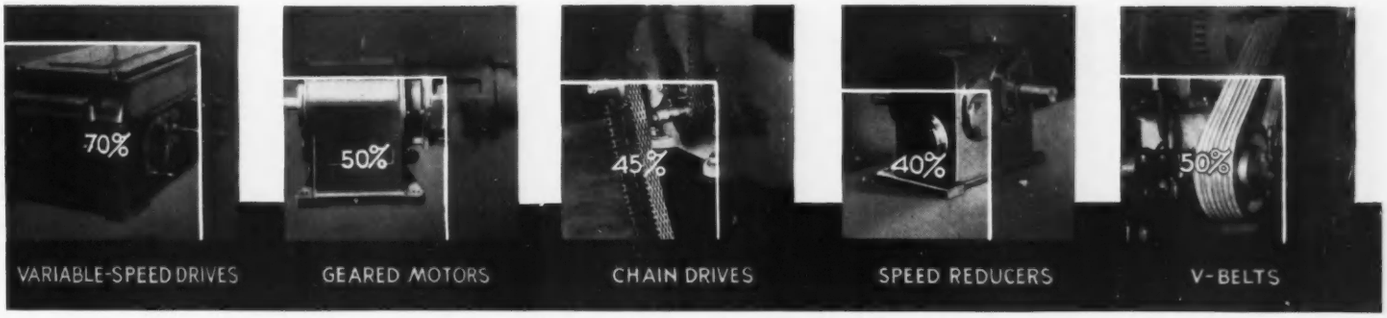
▼

REPRESENTATIVE manufacturers of cooking, canning and bottling equipment, milk pasteurizing and beer brewing apparatus, box making and packaging machinery are included in this group of 20 reporting companies. Compared to 1934, there has been an increase of 20 per cent in the number of engineers, draftsmen, and research workers employed.

As indicated by 70 per cent of the engineers reporting in this group, the primary aim in their new developments has been to make possible increased speeds of operation. But many of the machines in this group are of such a nature that the maximum permissible operating speed of a given machine will vary considerably throughout the cycle of its operation or under different conditions of operation. Thus, in mixing tanks there are wide variations in permissible speed because of variations in viscosity and temperature of the material being mixed. If driven at constant speed the agitator would have to be run at the lowest maximum speed permissible. Similarly, the maximum speed of milk pumps is limited to the speed at which foaming will take place. This speed will vary with the temperature of the milk. Also, in packaging machinery, bottle-filling machines and similar types of automatic machinery, the maximum operating speed will be different for the different sizes of packages being handled and the different types of wrappers.

It is this condition that explains the numerous new applications of variable speed drives as reported by 70 per cent of these engineers. Such drives make it feasible to always run the machine at the maximum permissible speed, and to quickly adjust the machine speed to the different conditions of operation or the particular type of work that the machine is doing.

Cleanliness is one of the principal requirements in food-handling plants. This has made desirable the elimination of line shafts, belt and open gearing, in order to avoid the danger of contamination from lubri-



Per cent of companies reporting extended use for five types of drives on food machinery

cating oil or particles of hardened belt dressing. Hence the strong trend to individual variable-speed drives for agitators and other machinery.

For the same reason, direct variable-speed drives are used for cooling or ventilating fans. Here the variable speed features have the advantages of making possible speed regulation to control the amount of cool air delivered to pre-cooling rooms. The old method was the use of a slip-ring motor. New methods result in appreciable power savings especially at low speeds.

In the above charts is shown the relative extended use of the various types of drives and transmissions. In addition to those indicated, variable diameter V-belt pulleys are finding many applications. They afford a simple and economical means of obtaining variable speed over a relatively small range. Increasing load increases belt tension which automatically reduces speed of driven pulley by changing the effective diameter of pulleys; or the speeds can be changed manually.

Higher speeds and efficiency may explain why 60 per cent of the reporting engineers indicate that they are extending the use of anti-friction bearings, or contemplate doing so. And the requirement for cleanliness may explain why 6 of these 20 engineers are using the sealed-type anti-friction bearings and 7 of them are making a more extensive use of the commercial type of unit seals. For similar reasons, and to avoid the possibility of discoloring the packages, 45 per cent of these designers are equipping their machines with oilless bearings especially for locations in close proximity to food products.

More use of speed reducers is reported by 40 per cent of these manufacturers, especially among the designers of brewing and distilling apparatus. In many instances, the reducer is placed above or on top of the tank, tub, cooker or kettle. This demands the use of fully-inclosed speed reducers, properly sealed to prevent oil leakage.

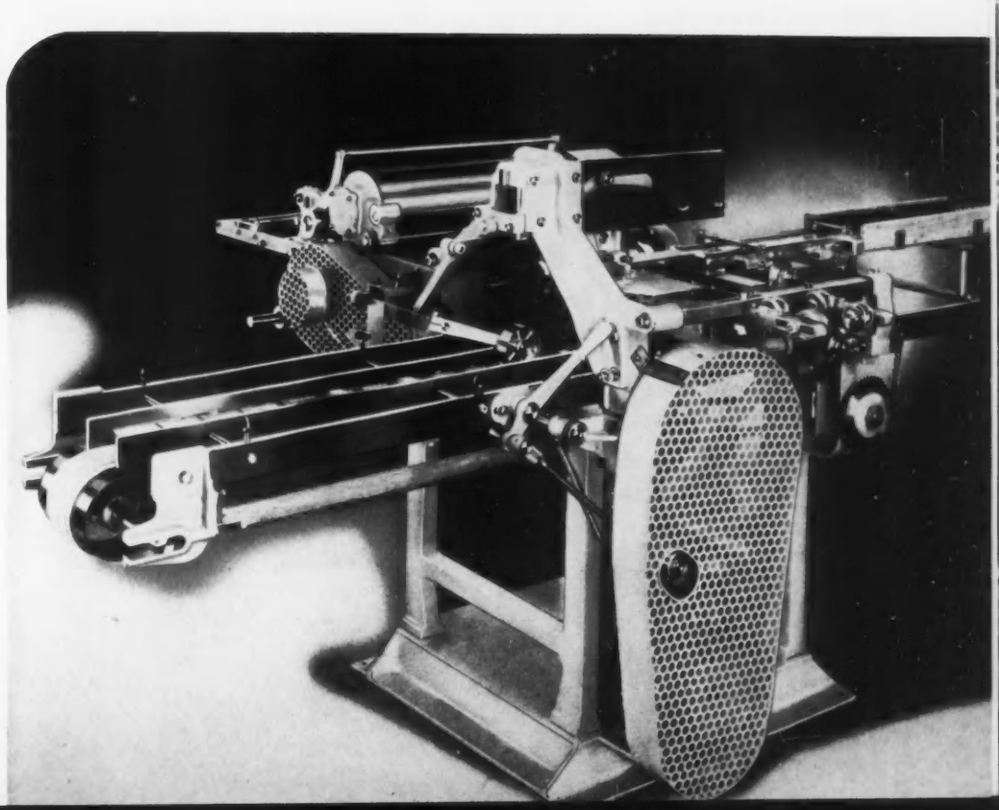
With reference to the driving element on packaging and bottling machinery, there is about an equal division in the choice of V-belts versus chain drives.

The general trend throughout industry for improved appearance is reflected in this field by 65 per cent of these companies reporting the greater use of stainless steel primarily for improved appearance. But the more general reasons for the use of stainless is to provide protection against corrosion, as reported by 73 per cent of these engineers.

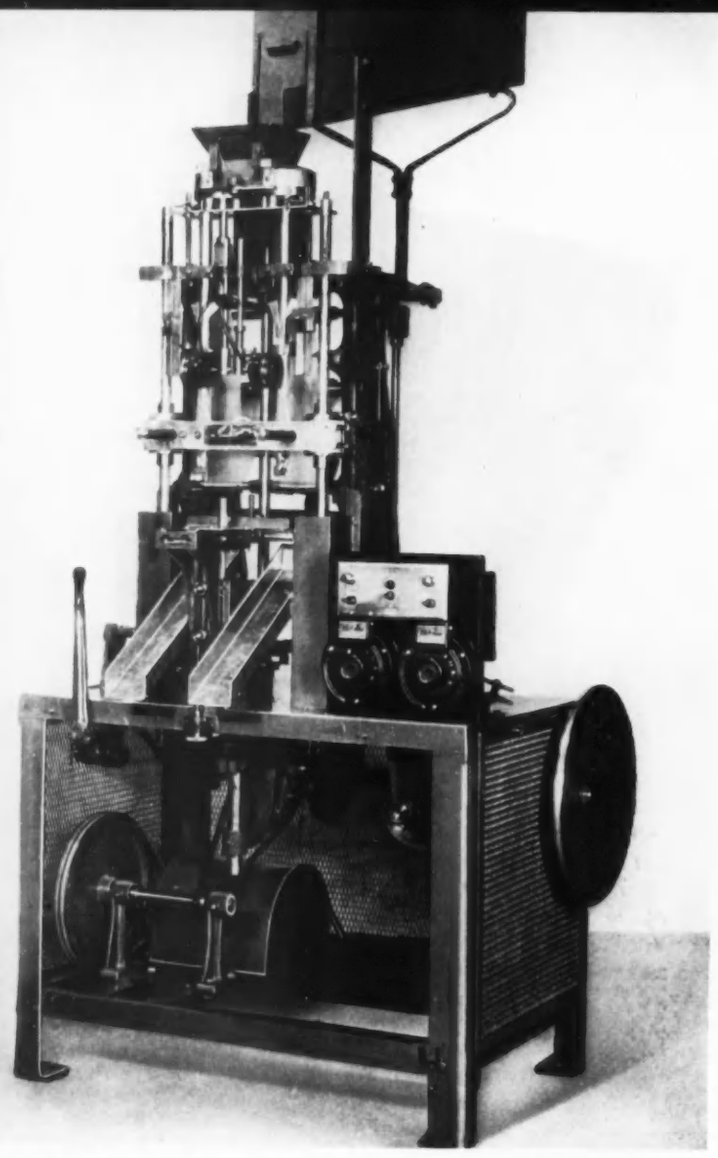
Stainless steel and aluminum are finding considerably more extended use, especially in dairy and cooking equipment. Stainless steel has been found highly satisfactory for fermentation tanks, breaking room vats, screens and churns for the powdered egg industry. In brewing and distilling, both stainless and aluminum have found many new applications. In food packaging machinery considerable use is made of stainless for shafts to avoid unsightly corroded parts.

Chromium plating is used by 45 per cent of these manufacturers, primarily for appearance, but also because of the added features of greater wear resistance and protection against atmospheric corrosion. For this latter reason, cadmium plating is also finding extensive application.

Easy and efficient cleaning has always been a problem in the design of food handling equipment. It is not



Increased utility through wider range of adjustment and increased speed of operation are features of the new wrapping machine made by the Package Machinery Company — one of three companies reporting extended use of electronic controls



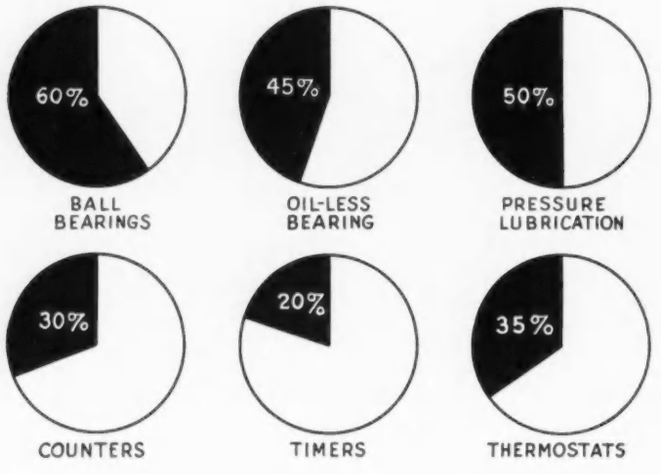
Aluminum alloys for reciprocating parts of the Trans-Wrap machine permit higher operating speeds

The material of the welding rods used is of the same analysis as that of the parent metal. All joints are ground and polished to make them as corrosive resistant as the parent metal and to facilitate cleaning.

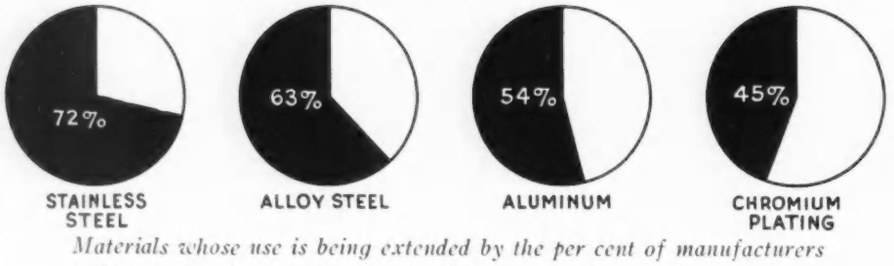
Many packaging and filling machines must be readily adjustable to handle different sizes and types of packages. Hence the desirability for unit assemblies and adjustability.

One engineer has developed some highly interesting mechanisms wherein gears in combination with eccentric cranks and short connecting rods give motions formerly obtained from cams and linkages. Advantages are savings in space and cost.

In line with the trends for more automatic operation



Per cent of food machinery designers obtaining greater marketability for their product through improved bearing lubrication, thermostats and production meters



Materials whose use is being extended by the per cent of manufacturers indicated, for increased strength, lightness and corrosion resistance

of food processing equipment, thermostats are being used more extensively by 35 per cent of these manufacturers, together with recording and indicating instruments. Of the concerns making packaging machinery, 5 are making more use of limit switches and 6 are specifying counters and timing devices. Electronic control for registering, sorting and inspection is becoming more general.

surprising that 65 per cent of these engineers reported the further extended use of hollow or socket head screws in order to have flush surfaces that will not catch dust and can be cleaned easily.

Conforming to the trend to higher speeds, 65 per cent of these companies report the extended use of high-strength alloy steels, particularly for shafts, gears, cams, cam rollers, ratchets and guides. Weight reduction to keep down inertia forces is the primary reason, for which reason aluminum alloys are also finding a more extended use. Two designers are using Dowmetal.

With reference to the type of construction, both fusion welding and resistance welding are being used more extensively. Tanks, vats, kettles and other food containers are being made of stainless steel and welded.

In the past, one of the difficulties in fabrication with stainless steel has been the difficulty of machining it. This has been overcome now by the addition of selenium to the 18-8 steel, making it a relatively free machining material. The corrosion-resisting properties of this free machining stainless steel are equal to those of the regular stainless. Drilling and lathe operations are much easier.

Silver solders, have been finding a more extended use in making tanks, heaters, kettles, stills and similar applications where non-ferrous metals need to be permanently joined. Advantages are strength and ductility, hence good resistance to shock and vibrations. Sil-Fos, manufactured by Handy & Harman, 80 per cent copper and

15 per cent silver, has exceptional corrosion resistance, hence its extensive use for process equipment.

A new brazing alloy made by the same company and known as Easy-Flo has been developed for joining ferrous to non-ferrous metals including stainless, Monel, Inconel and similar alloys. Easy-Flo is 50 per cent silver, 15.5 per cent copper, plus equal portions of zinc and cadmium. Melting point is 1,160 deg. F., and it is free flowing at 1,150 deg. F. It has the lowest melting point of any brazing alloy and yet will make a joint with practically the strength of steel. Together with the development of these solders, new fluxes are available.

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Trends in Construction, Farming and Mining Machinery

Power-operated clutches and high-strength steels feature construction equipment; alloy cast iron and oilless bearings in farming machinery. More attention to lubrication and welding.

THIS group of 28 companies includes 14 manufacturers of construction equipment, 5 manufacturers of farming machinery and 9 manufacturers of mining machinery. The total number of engineers, draftsmen and research workers in the 28 companies increased less than 5 per cent, but it is significant that, on the basis of estimates submitted, an increase of 10 per cent more is expected during the coming year.

Greater mobility and higher speed of operation are the primary aims in construction equipment and mining machinery. Hence, a strong trend towards more welded construction, primarily for the purpose of weight reduction; while greater speed of machine operation has compelled refinement in power controls and transmissions.

As an example of welded construction, the new P & H Bantam weight crane is described as being "all-welded." The 25-ft. boom of this crane is of welded tubular construction. The railroad-type truck on which it is mounted is all-welded.

Faster speed of operation is responsible for the trend to power-operated clutches, not only to relieve the operator of the effort required to throw the clutches, but also to make possible a more rapid and accurate control of the machine. Higher speeds of operation has also made desirable decreased weight in order to reduce

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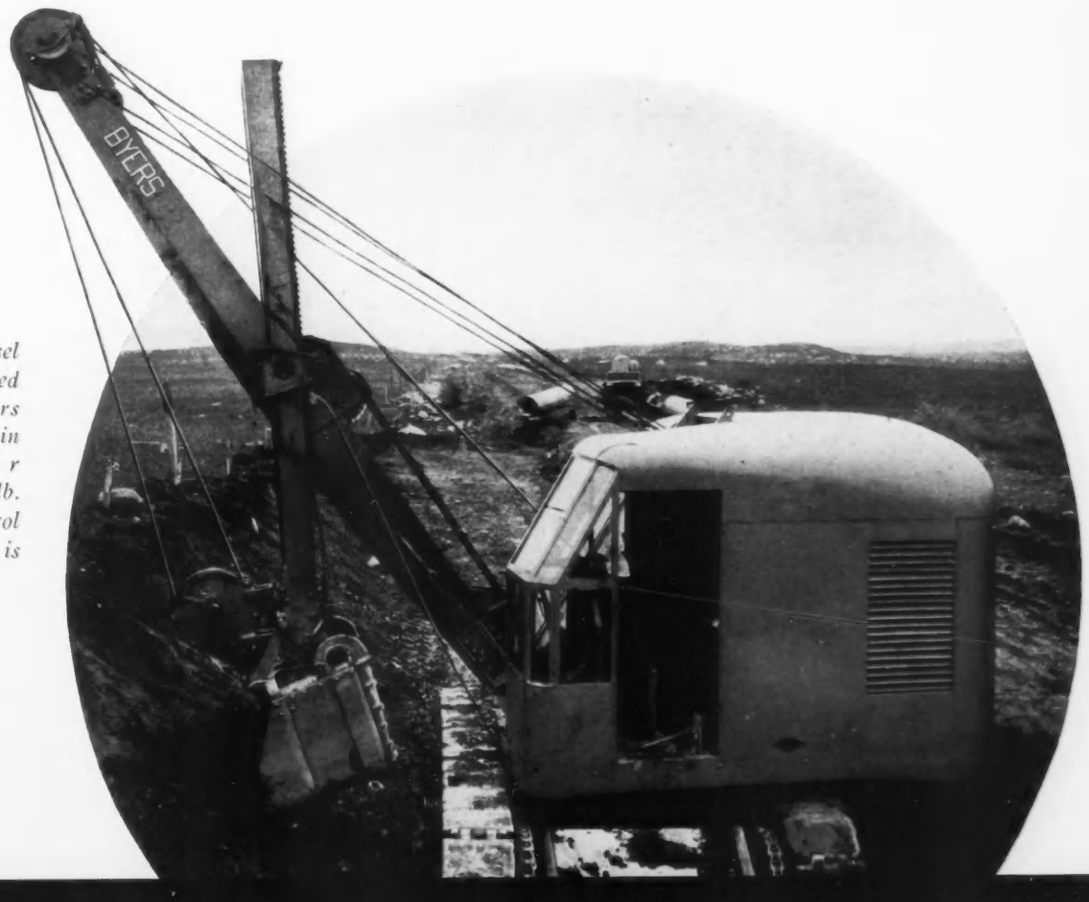


New Byers shovel—diesel powered, Timken equipped —with sliding cab doors for operator's comfort in any weather. Power clutches require but 5 lb. pressure on the control lever and bucket trip is power-operated

inertia effects. High-strength alloys are also being used for portability.

Refinement in power transmission is reflected in the number of companies that are extending the use of anti-friction bearings, as shown in the accompanying table. The trend to oilless bearings for farming machinery is significant. In the powering of construction machinery, the trend is strongly toward diesel engines, although there are still quite a number of gasoline powered shovels and cranes being made.

Trends in Bearing Design

Per cent of companies extending the use of ball and roller bearings, oil seals and lubricating devices

Type of Equipment	CON-STRUCTION	FARMING	MINING
Number of Companies	14	5	9
Anti-Friction Bearings	100 per cent	60 per cent	89 per cent
Integral Seals	57 " "	40 " "	33 " "
Separate Seals	71 " "	60 " "	56 " "
Oil-less Bearings	22 " "	80 " "	33 " "
Pressure Lubrication	28 " "	40 " "	22 " "
Oil Filters	22 " "	40 " "	22 " "

Of the 14 manufacturers of construction equipment included in this survey, four report recent or contemplated extended use of hydraulic operating units. These are applied primarily for such purposes as raising and lowering mold boards and the like.

During the past year there has been a distinct trend to "streamlined" design, one example of which is shown in the accompanying picture of the Byers shovel. Along with appearance, more attention is being given to the comfort of the operator, which is reflected in the design of the cab.

Along with the use of welded construction to reduce weight, designers of construction machinery have been using aluminium for the booms of dragline scrapers. Aluminum dippers are a new development. A coal dipper built by the Marion Steam Shovel Co. has body sheets of $\frac{3}{4}$-in. thick aluminum alloy plate, with cutting lip of manganese steel, fitted with renewable points. This dipper of 16-cu.yd. capacity when loaded weighs 39 tons, slightly less than the gross weight of a 12-cu.yd. steel dipper manufactured by this company.

Wear, always a major problem in the design of construction equipment, accounts for the extensive use of hard-facing materials and wear-resisting alloys. Nitralloy and manganese steel are being used to an increasing extent. The latter is also applied as a facing, deposited by welding. Hard facing with weld deposited Stellite is in general use.

In construction machinery, and to a greater extent in farming machinery, rubber tires are more popular. The primary purpose is to increase safe speeds of travel over highways.

With reference to farming machinery, alloy cast irons are replacing ordinary gray irons. And, because such equipment does not receive the service attention that is given to general manufacturing and industrial machinery, self-lubrication is an important factor and a distinct sales advantage. Hence the increasing trend

For increased operating speeds and greater output, all reporting designers of shovels and road-building machinery are extending the use of anti-friction bearings, sealed for protection. Other features include improved drives and controls, and weight reduction through further use of welded construction, high-strength steels and aluminum alloys. The Link-Belt shovel and Caterpillar grader shown here are two examples

to oilless bearings of the graphited type as well as oil-impregnated bronze bearings.

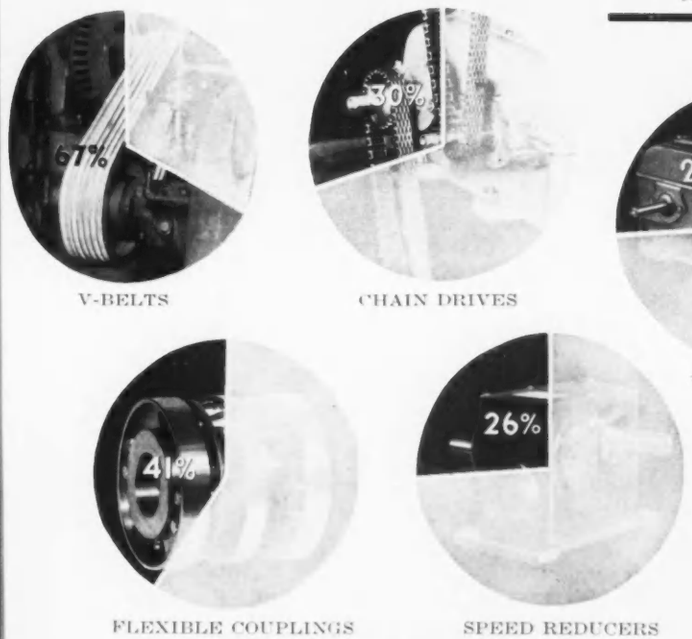
To meet bearing requirements in construction machinery, every designer in this group reports extended application for anti-friction bearings. More than 70 per cent are finding extended uses for separate bearing seals. With the high-bearing loads ordinarily existing it is not surprising to find a large number using pressure lubrication, oil filters and centralized lubrication to a greater extent. In the literature of one of the companies centralized lubrication is set forth as a strong sales feature. The designer in another company rates continuous lubrication of bearings next to appearance in importance.

In elevating graders made by one company anti-friction bearings with separate seals are designed into conveyor belt rollers, drive shafts and clutches. According to another manufacturer, "We are now using pressure grease gun fittings throughout to lubricate inclosed anti-friction bearings. Seals have been adopted to prevent loss of lubricant and entrance of dirt. Wheels are mounted on tapered roller bearings which are also sealed and lubricated with pressure grease fittings."

The use of sleeve bearings is being extended by 6 manufacturers in this group, 5 of them reporting the extended use of seals for these bearings. One designer states that copper-lead bearings successfully withstand high unit pressures, and that their further adoption is contemplated.

Haynes Stellite Company

Cutting edges subjected to wear and abrasion are being hard-faced by a deposited layer of wear-resisting material, or by tungsten-carbide inserts cast into the base metal



Types of drives receiving greater attention and per cent of reporting manufacturers of mining and construction machinery adopting them

Among the types of drives being adopted, V-belts show the highest per cent in all three groups. Of the 30 per cent reporting extended applications for chain drives, and the 26 per cent for variable-speed drives, the largest number are designers of construction machinery. On the other hand, speed reducers and geared motors are being given more attention by designers of mining equipment than by engineers in the other two groups.

Materials being selected to a greater extent in all three groups include high-strength steel, alloy cast iron and stainless steel. As shown in the table on the following page, stainless steel ranks first among the alloys being given preference in the design of mining equipment. Among designers of farm equipment alloy cast iron is reported unanimously for extended adoptions. In construction machinery, the necessity for weight re-

Lukenweld, Inc.

Lower costs and greater flexibility in design of welded structures is now obtainable through the use of improved equipment for flame cutting

duction has lead to greatly increased use of high-strength alloy steels. This development has been influenced also by recent developments in welding materials and flame-cutting.

Use of high-strength steels is being extended by a majority of the mining equipment designers also. Cutting chains for coal mining machines are now being made of heat-treated nickel alloy steels selected for impact resistance as well as high strength. Clutch jaws, armature pinions and gears subjected to severe duty are being made of nickel steel for toughness. In this same group, and in construction machinery as well, hard-facing alloys are now being adopted more extensively in original design, as indicated by the accompanying table.

In the group as a whole, recent developments in welding have played an important part in improving performance and reducing weight. New welding rod materials as well as improved welding methods, flame-cutting and more flexible welding machines account for it. The number of parts are reduced, and strength is increased by eliminating bolted or riveted connections in large bases and frames.

In shaping parts to be welded, the recent development of automatic flame-cutting machines has been a factor. Machining costs are reduced by flame-cutting each part to shape. Using a pantograph device these shapes can be cut directly from blueprints or drawings, eliminating layouts on the stock. Cutting speed in this device is automatically controlled by a built-in motor drive for the tracing head.

One of the outstanding trends in the design of coal mining machinery is multi-motoring. One coal-loading machine uses five motors, entirely eliminating clutches, transmissions and differential units. With reference to materials used, alloy steels, largely nickel and nickel-chromium are used most extensively to meet the requirements of wear resistance, strength and toughness.

One of the recent developments in finishes is the availability of aluminum paint with paste for the pigment materials. This paste is made by reducing the metal to a fine powder in the presence of mineral spirits, the resulting pigment then being mixed with a suitable vehicle to produce the aluminum paint. This new paint is claimed to possess better hiding power, and superior light reflectivity. It finishes smoother, does not collect dirt as readily and may be cleaned more

High Strength and Wear-Resisting Materials

Per cent of companies extending use of materials for reducing weight and increasing strength and resistance to wear and corrosion

Type of Equipment	CONSTRUCTION	FARMING	MINING
Number of Companies	14	5	9
Low-Alloy Steels	55 per cent	60 per cent	23 per cent
Stainless	32 " "	20 " "	89 " "
High-Strength Steel	100 " "	40 " "	56 " "
Alloy Cast Iron	71 " "	100 " "	67 " "
Hard Facing	45 " "	20 " "	56 " "

easily. It has the advantage that, unlike powder, the newer pigment material does not blow away as a dust during mixing.

The following interesting remarks were contributed by various engineers in this group. One designer of dragline scrapers states, "Most attention is now being given to appearance and the continuous lubrication of bearings not readily accessible. Reduction of weight comes next, with color schemes last. We have a uniform color combination for all machines."

A designer of road machinery states, "We are using special aluminum paint for its weather resistance."

A designer of tractors writes, "One of our aims is to develop industrial type tractors with higher travel speeds, using various types of rubber tire equipment."

"Lighter weight, improved appearance, general use of arc-welding, higher speeds of travel, and lower costs are the principal features of the new products developed during the past year," is the comment of a designer of farm equipment.

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Materials Feature Changes in Design of Transportation Vehicles

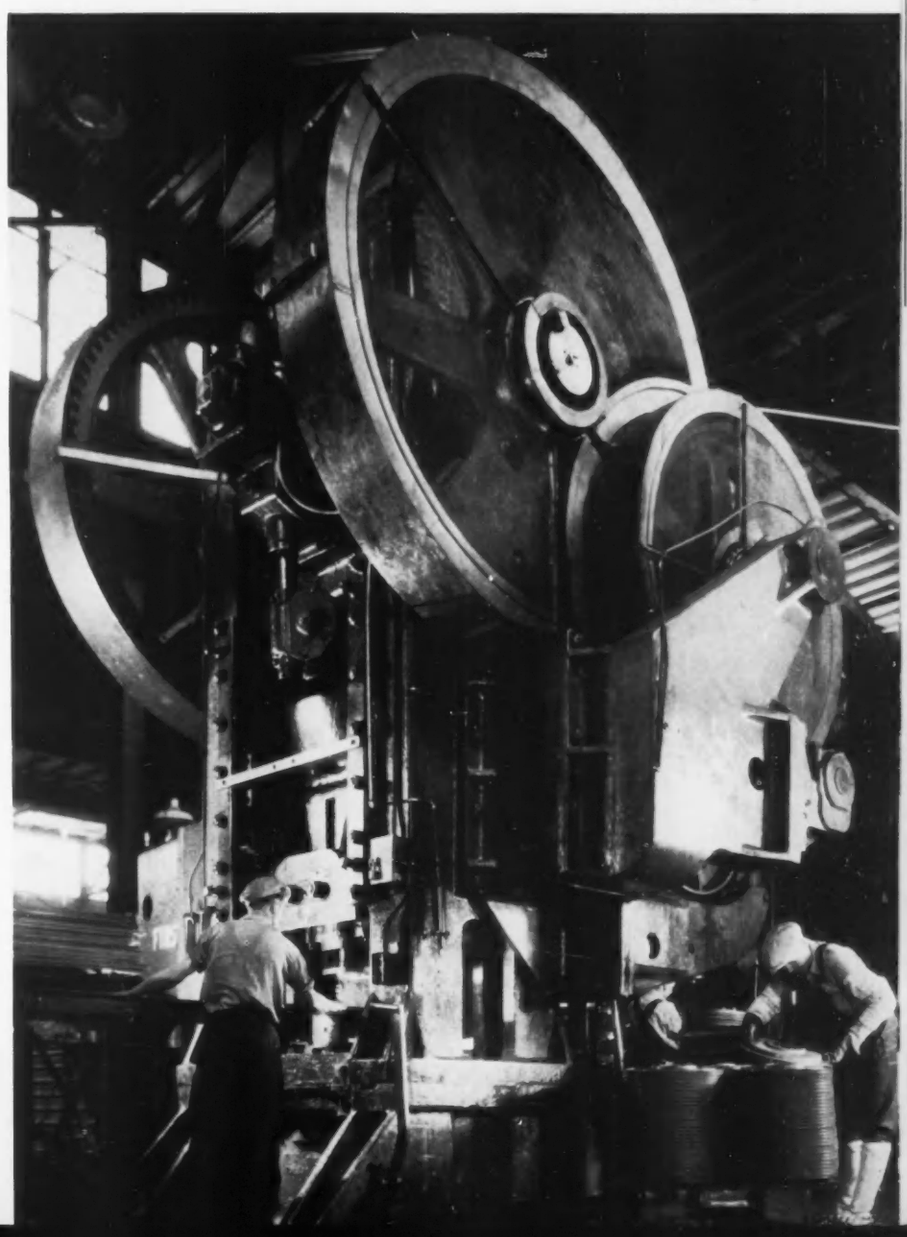
Many new applications of low-alloy steels, stainless, aluminum, and plastics. Larger die-castings for automobiles. New flexible glass used in airplanes. Noise reduction receiving much attention.

AUTOMOBILES, railway equipment and aircraft engine manufacturers are included in this group of 27 reporting companies. In the automotive field, an increase of 17 per cent in the employment of engineers is reported, but in the manufacture of railroad equipment the numbers are the same as in 1934. Aircraft concerns report an increase of 25 per cent over last year, with an estimated further increase of 12 per cent during the coming year.

With appearance the most important factor, the 11 automobile manufacturers in this group report a continuing trend to the greater use of chromium plating, polished stainless steel and more durable finish. The latter is reflected in the more extensive use of chemical rust-proofing. One manufacturer, Ford, is now using a synthetic resin finish in place of nitrocellulose lacquer, primarily for greater durability.

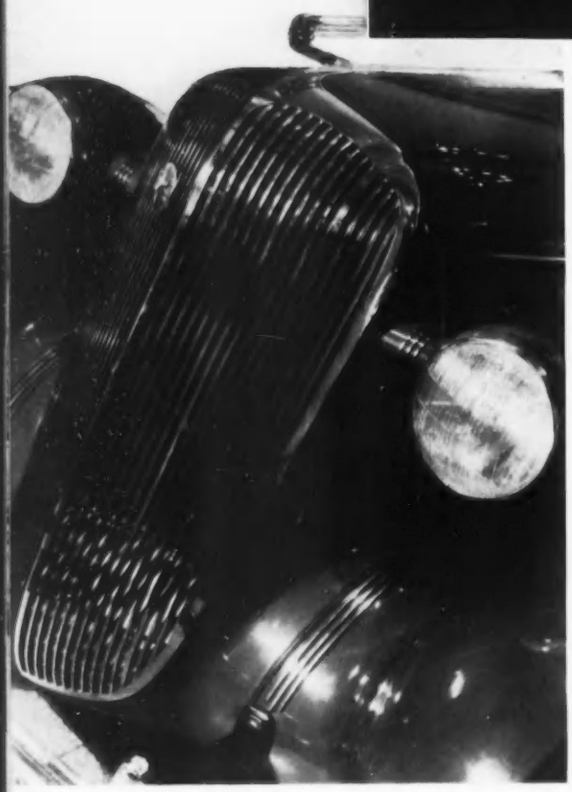
Use of stainless steel is being extended in hub caps, lamp brackets, instrument panels, bumpers and fenders, cowling

Kaufmann-Fabry



Developments in resistance welding and improved deep-drawing steels have fostered a more extensive use of stampings, usually reducing manufacturing costs

Cascades of sparks fly from the jaws of the giant welder as body panels for the Ford V-8 are fused into a single piece at the rate of more than 1,100 per day. Resistance welders such as this one, have made the one-piece body possible



Constantly striving for better appearance, automobile designers are adopting die-cast radiator grilles for nearly all 1936 models. This is the Buick front end. Even instrument panels are being die-cast in some of the higher-priced cars

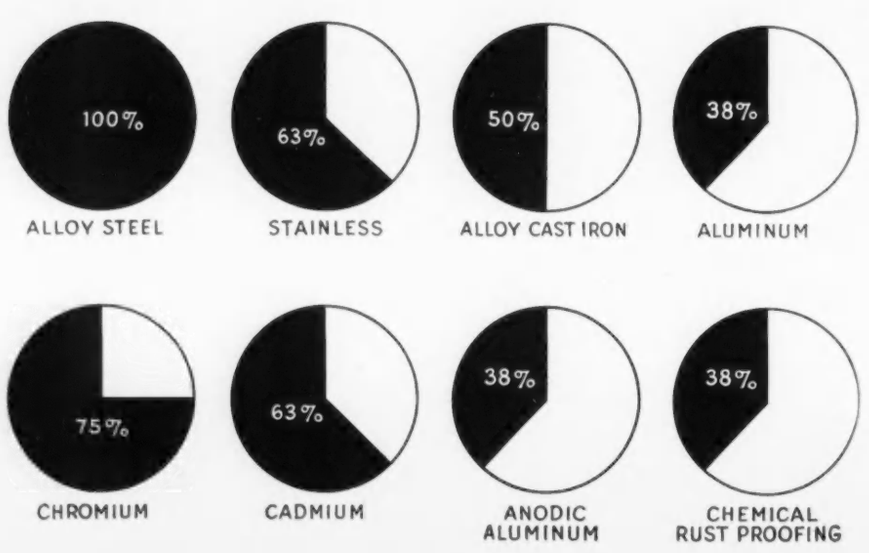
trim and tire covers, as reported by 65 per cent of these manufacturers.

Streamlining has definitely extended to the motor truck field. Increased wind-resistance and gasoline economy are minor advantages. Truck operators appreciate the advertising value of smart-looking equipment, hence the sales advantage of streamlining.

With reference to cast-iron crankshafts, Campbell Wyant & Cannon Foundry Company, state: "We are now making regularly a Proferall electric furnace metal crankshaft for high-speed motors, even including the largest diesel engines. The metal has been approved for that purpose by the Navy and has been adopted as standard for certain types of marine engines."

The streamlined type of passenger car with its greater over-all length, plus the demand for more passenger space within the car, has materially contributed toward increased weight. The result tends to lower horsepower-weight ratio which is being combated in two ways, higher output from the same sized engine and decreased weight through light-weight materials.

For decreased weight, aluminum pistons, according



Types of alloys and finishes receiving greater attention and per cent of automobile manufacturers adopting them. Resistance to atmospheric corrosion as well as appearance are the reasons given for the trend to the plated finishes and chemical coatings charted in the bottom row

to information now available, will make a great gain in the 1936 models. Present indications are that not more than two makes of 1936 cars will have iron pistons. Die-cast radiator grills which first made their appearance quite recently are being widely adopted for 1936 models.

Resistance welding, both electric spot and butt welds are being used to an ever increasing extent. This is one of the results of the aim for a one-piece, all-steel body, including the roof. Advantages are decreased weight, greater stiffness of the body, greater safety and reduced labor costs.

Plexite glare-proof glass for automobile rear windows has recently been developed, and promises to find acceptance among automobile designers. This safety glass is colored to prevent the glare of strong headlights coming through the rear window and blinding the driver by reflections in rear-view mirror and windshield.

Among manufacturers of railroad and similar equipment, 50 per cent report extending the use of fusion welding, 56 per cent are contemplating using more anti-friction bearings and 50 per cent are finding more use for unit oil seals. Oilless bearings are reported by 56 per cent and pressure lubrication and the use of flexible tubing by 50 per cent.

With reference to materials of construction, the newly developed low-alloy high-strength steels is being extended by 43 per cent of these manufacturers, while 42 per cent are extending the use of the high-strength high-alloy steels. Stainless is receiving the attention of 71 per cent and alloy cast irons 30 per cent. For lightweight, aluminum alloys are coming into more extensive use, as reported by 57 per cent of these manufacturers. One significant fact is that 80 per cent are reporting more use of color for appearance.

Noise isolation and heat insulation is now considered one of the most important factors in railroad passenger cars. Oillite plates with rubber facing vulcanized on one side are now commonly used for center plates. Trucks are usually completely sound insulated with rubber pads and thimbles.

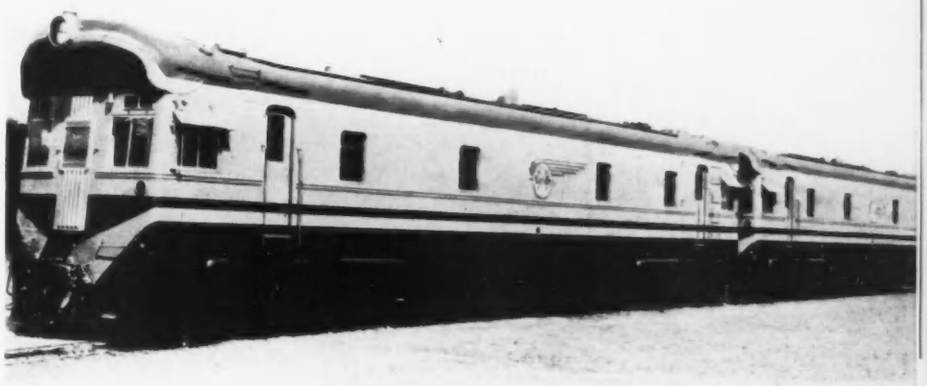
Passenger car floors are made with ground cork or similar insulating material, and covered with rubber or cork tiling, thus giving both heat insulation and sound deadening. Windows are of safety glass, many of them double glazed with the air between dehydrated and completely sealed with plastic putty. This new development has been applied to all the new streamlined trains and practically all of the new passenger cars for steam and electric railways as well as for airplanes.

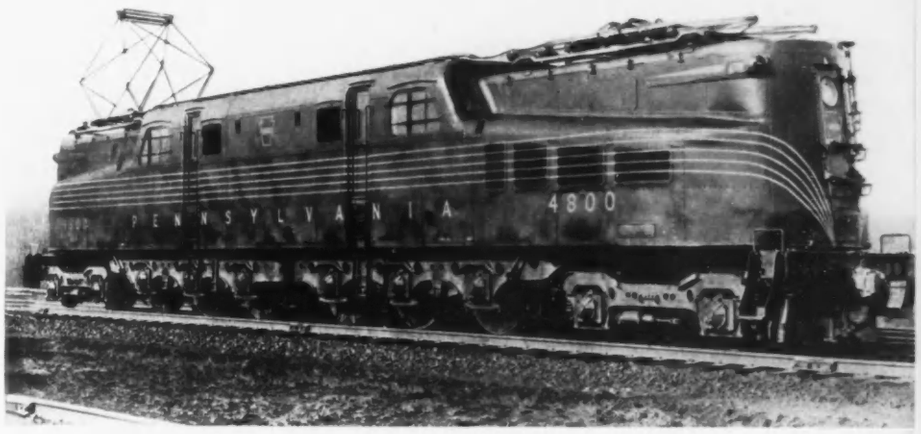
Indicative of the attention being given to weight reduction, aluminum is being used extensively in the air brake equipment. This includes air brake cylinders, slack adjusters, control valves, relay valves and small reservoirs. The main supply tank is of stainless steel.

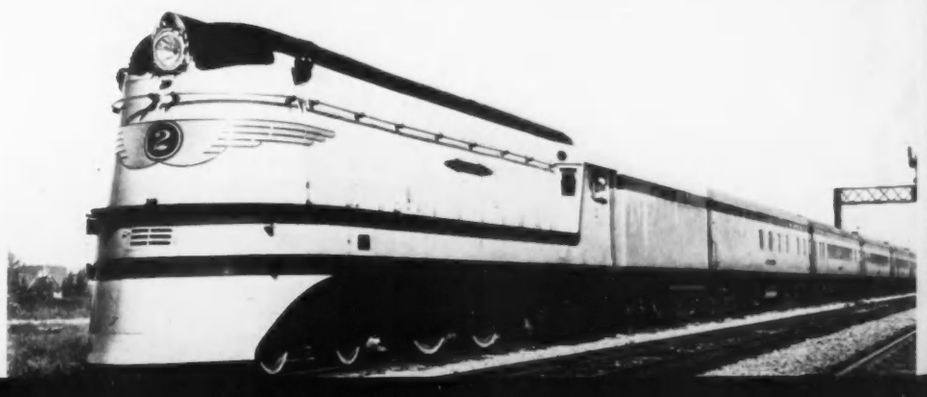
As additional protection against failure, piping in lines and for air-conditioning equipment are of seamless copper tubing with sweat-on fittings to insure against both scale and leaks.

One outstanding development in the steel industry this year has been the introduction of low-alloy, high-tensile steels which have found wide acceptance for railroad cars, tank cars and similar applications. This steel is available with a minimum yield point of 60,000 lb. per sq. in., and 75,000 lb. per sq. in. ultimate with 25

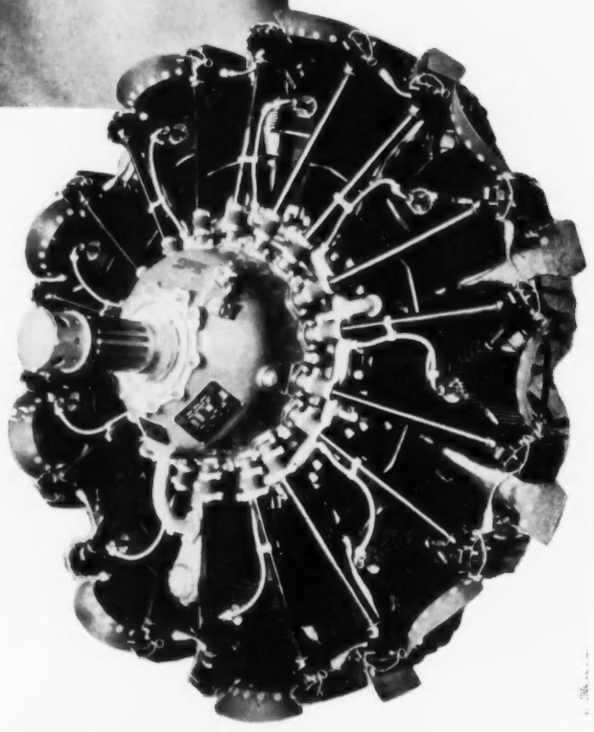
Record breakers in railway motor power—The Santa Fe diesel locomotive built by the Electro-Motive Corporation, rated at 3,600 horsepower—One of the Pennsylvania's new fleet of streamlined electric locomotives, built by Baldwin using General Electric equipment—The Hiawatha, a streamlined steam locomotive built by American Locomotive for the Chicago, Milwaukee & St. Paul







First of a fleet of new Douglass planes being placed in service by American Airlines. These ships are powered by the latest 700-hp. Wright Cyclone engines, shown below, which have a dynamic damper on the crankshaft and an automatic lubricating system for the valves



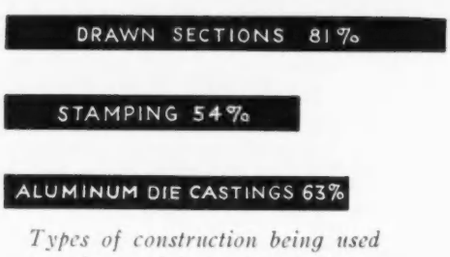
per cent elongation in two inches. Another grade has 70,000 minimum yield point and 90,000 ultimate tensile with 18 per cent minimum elongation. The material has excellent forming qualities and is particularly adapted to welded constructions, the welds showing excellent corrosion resistance. This steel promises to supplant the copper-bearing steel because of its greatly superior corrosion resistance.

Among the designers of aircrafts and aircraft engines, one of the outstanding developments is the greatly extended use of beryllium copper for its high strength, corrosion resistance and fatigue strength, as reported by 20 per cent of these companies.

New developments include rubber-cork compositions faced with Synthane for noise isolation purposes. Of these manufacturers, 40 per cent are using rubber primarily for noise isolation, and 30 per cent are using felt for the same purpose.

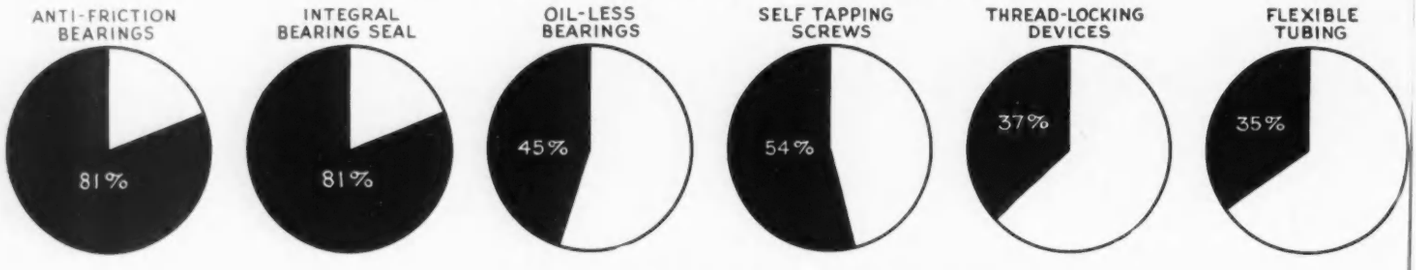
With reference to finishes, cadmium plating is being used more extensively for its corrosion resistance and 88 per cent are applying the anodic treatment of aluminum. Lacquer is also being used extensively, with more attention being given to color and finish in the interior of passenger carrying cabin planes.

In the new Whirlwind 9-cylinder airplane engine, exhaust manifold is made of stainless steel for its corrosion resistance. Pistons are machined from high-tensile aluminum alloy forgings. Piston ring type oil seals have replaced leather seals previously used on the impeller shaft and at the crankshaft thrust bearing. Oil



Types of construction being used to reduce weight in aircraft design

Parts and units being given increased attention among the airplane designers, as reported by the per cent of manufacturers indicated in these charts



tightness in the crankcase sections has been made more positive by rubber inserts between the cylinder and crankcase flanges.

Cylinders are of forged steel barrels and cast aluminum heads with cooling fins cast integral. The crankcase is in five major sections of light-weight, high-tensile aluminum alloy, and connecting rods are of forged nickel steel.

Chrome-molybdenum steel tubing is extensively used for fuselage, as exemplified in the new Master C-3 Aeronca, a two-passenger full-cabin plane. It is the first aircraft engine with quill or needle bearings on the crankshaft to be approved by the Department of Commerce.

A special type of safety glass is now being used by the majority of the manufacturers of airplanes. This new type of safety glass has rubber between the two sheets of glass. It has the advantage that the edges of the glass need not be sealed and the glass possesses remarkable flexibility.

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Materials for Household Equipment Selected for Their Appearance Value

Stampings assembled by resistance welding and thread-forming screws replacing cast iron. Drawn and extruded shapes used more extensively. New finishing materials and molded plastics finding wide acceptance.

AMONG the domestic appliances made by the 32 manufacturers reporting in this group are radios, refrigerators, stoves and heaters, clothes and dishwashers, ironing machines, clocks, scales, toasters, waffle irons, vacuum cleaners. For the total of all of the reporting companies, there has been a 22 per cent increase in the number of engineering employees.

Relative to the general aims in this field of design, the following comments contributed by various engineers in this group are of interest. A designer of scales reports: "Due to price competition, we find it necessary to go more extensively into steel stampings and eliminate cast iron formerly used." This designer also reports a trend to synthetic resin lacquers. A designer of electrical devices for the home states: "Redesign this year has not been fundamental but rather for appearance." The chief engineer of a stove manufacturer reports: "We are applying the new hi-bake enamel to certain exterior stove body parts that are not subjected to high temperatures." The chief engineer of a radio manufacturer writes: "The use of rubber-insulated wire has also been extended, due to the development of rubber-insulating compounds that can be used at higher temperatures." Referring to household refrigerators: "The trend in household refrigeration is toward lower-priced refrigerators, more efficient in operation and better in over-all appearance." A designer of refrigerator cabinets or refrigerators: "Am using porcelain enamel for appearance and sanitary reasons, anodic coating for the ice trays and chemical rust-proofing for the cabinets."

Seam welding plays a most important part in the design of Westinghouse electric refrigerator cabinets. Of the reporting manufacturers, 75 per cent are extending the use of resistance welding

The accompanying bar charts

Republic Steel Company

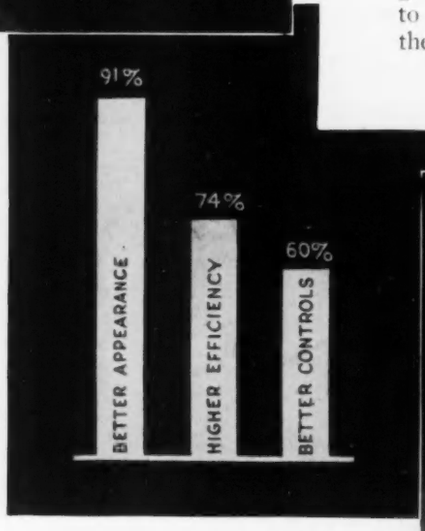
Improved grain structure as a result of closer metallurgical control in cold-rolled sheets is one reason for the increased use of stampings in household equipment

rust. The stainless portion is 20 per cent of the thickness, the base sheet being mild, low-carbon steel. Heating of the shoe is by electric heating elements, fastened by lugs to the mild steel.

In a recent development of galvanized sheets, the zinc and steel are alloyed at the surface, the zinc actually penetrating the steel so that there is no definite line of demarcation between the zinc and the base sheet. This eliminates the necessity of galvanizing a product after it has been completely fabricated. Such sheets can be stamped, drawn, spun or seamed without damaging the zinc coating. The zinc provides a better base for lacquer, paint, enamel or whatever finish may be applied. It is claimed that such sheets will not flake even where rapid and extreme temperature variations occur.

With further reference to protective coatings, the trend is now toward tin electroplating rather than tin dipping, this giving a smoother surface of uniform thickness.

One of the major problems in porcelain finishing has been the difficulty of getting pure white finishes on cast iron. Lead has been a necessary ingredient of the porcelain frit in order to give it the proper fluidity and thereby hold down the impurities in



clearly indicate how improved appearance is the principal aim among these designers, together with higher efficiency and better controls, choice being in the order named.

With reference to methods of construction, 88 per cent report an increasing use of stampings, 64 per cent are using more plastics, 42 per cent more resistance welding, 36 per cent more drawn shapes, 32 per cent more aluminum die-castings, and 24 per cent more zinc die-castings.

Of the materials being used, 62 per cent are extending the use of stainless steel, and 48 per cent the use of aluminum.

Ingersoll Steel & Disc Company are making an ironer shoe, for a domestic type ironing machine, out of stainless clad steel. Corrosion resistance was one factor, abrasion resistance to scratching and gouging from buckles and buttons was another. Hence, a cutlery grade of stainless was chosen, the stainless portion being hardened, file hard. This cutlery grade also supplied adequate corrosion resistance, so that the work going through the ironer could not be stained from

Among designers of household devices improved appearance is now getting most attention

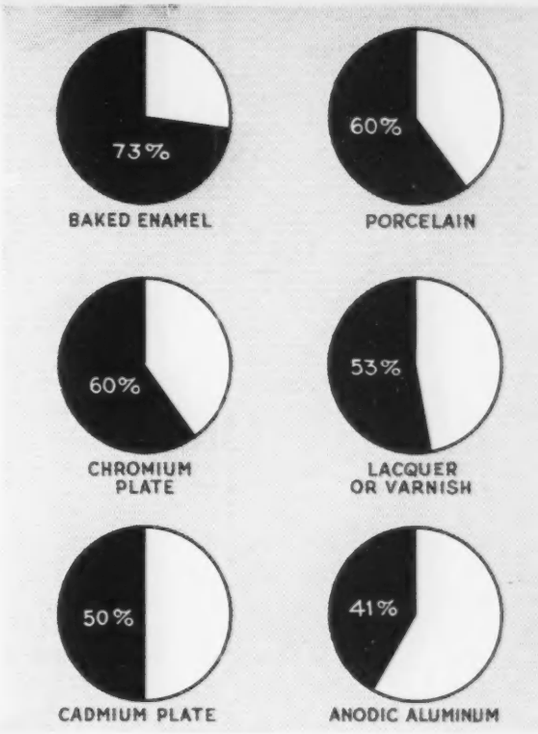
Porcelain enamel finishes are being adopted for resistance to heat and corrosion as well as for better appearance

the iron. Leadless frit could only be used with specially high-grade cast iron relatively free of impurities. There has now been developed a leadless ground coat suitable for any commercial grade of cast iron, and also a leadless frit for the finishing coat. These frits give a pure white porcelain that matches exactly with the white porcelain on the sheet steel part of the stove or other products.

Interesting developments are foreseen in the application of plastics and die-castings. One company reports experimenting with the possibility of replacing a die cast housing with molded plastics. In this particular instance the possibility of using a transparent material with an attractive surface finish is considered of great advantage.

One outstanding development has been the new line of plumbing and kitchen equipment designed and built by the Briggs Manufacturing Company. Dishwashers, sinks, cabinets and similar products are of sheet steel finished in porcelain enamel. This required designs of large stampings that would not warp when firing the enamel and would not crack the enamel upon cooling.

Among new applications of materials as reported are zinc-alloy die-cast housings for automobile radios, Ni-Resist for the body, worm and rings of meat choppers, the same material for potato peeling machines and dishwashers where strength and resistance to wear and corrosion are required, cutlery using the new heat-treatable stainless steel, lacy radio grills made of Tenite, stainless steel for refrigerators, aluminum alloy die-castings for food mixers and a sewing machine with the frame made of aluminum alloys. A line of cooking utensils made of Ni-Resist has just been placed on the market.



Per cent of manufacturers reporting increased use or contemplated adoption of various types of finishes for better appearance and increased resistance to wear and atmospheric corrosion

Parker-Kalon Company

Assembling with Hardened Metallic Drive screws, one of the types of thread forming screws whose use is being greatly extended

Porcelain Enamel & Manufacturing Company

Plaskon radio cabinets in pastel shades made their appearance among the new models this year. Available in a wide range of colors, these cabinets can be selected to harmonize with any color scheme. Colored telephones are now offered in molded plastics. Soft rubber plugs are now standard equipment on many electrical appliances. Rubber for plugs is obtainable in a variety of colors to match the cord and harmonize with the device on which it is used.

For thermoplastic molding compounds, such as cellulose acetate, injection molding is coming into more extensive use. This molding procedure is comparable to the die-casting process. Molding compound in plastic state is forced through small duct with a constricted orifice and into the closed mold. Orifice and small diameter duct are essential to assist in heating and

homogenizing the mass and permit ready removal of spruce when the mold is full.

With the more extended use of stampings and drawn shapes there has come about the further application of resistance welding for assembly operations. Electric refrigerator cabinets and electric ranges are now flash welded, thus giving a one-piece construction free of joints or seams. Evident advantages in addition to low cost are smooth surfaces and greater rigidity.

Another significant development along the same lines is that 75 per cent of the radio manufacturers and 43 per cent of the household equipment manufacturers report that they are making more extensive use of thread-forming screws such as manufactured by Parker-Kalon and Shakeproof Lock Washer Company.

As shown in the chart on the previous page anodic finish for aluminum and cadmium plating are receiving attention from a large number of designers. Protection from atmospheric corrosion is given as the most important advantage, with better appearance a close second.

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Motor Drives Feature Business Machines

Better controls and resilient mountings for noise isolation incorporated in new machines. Appearance an important factor

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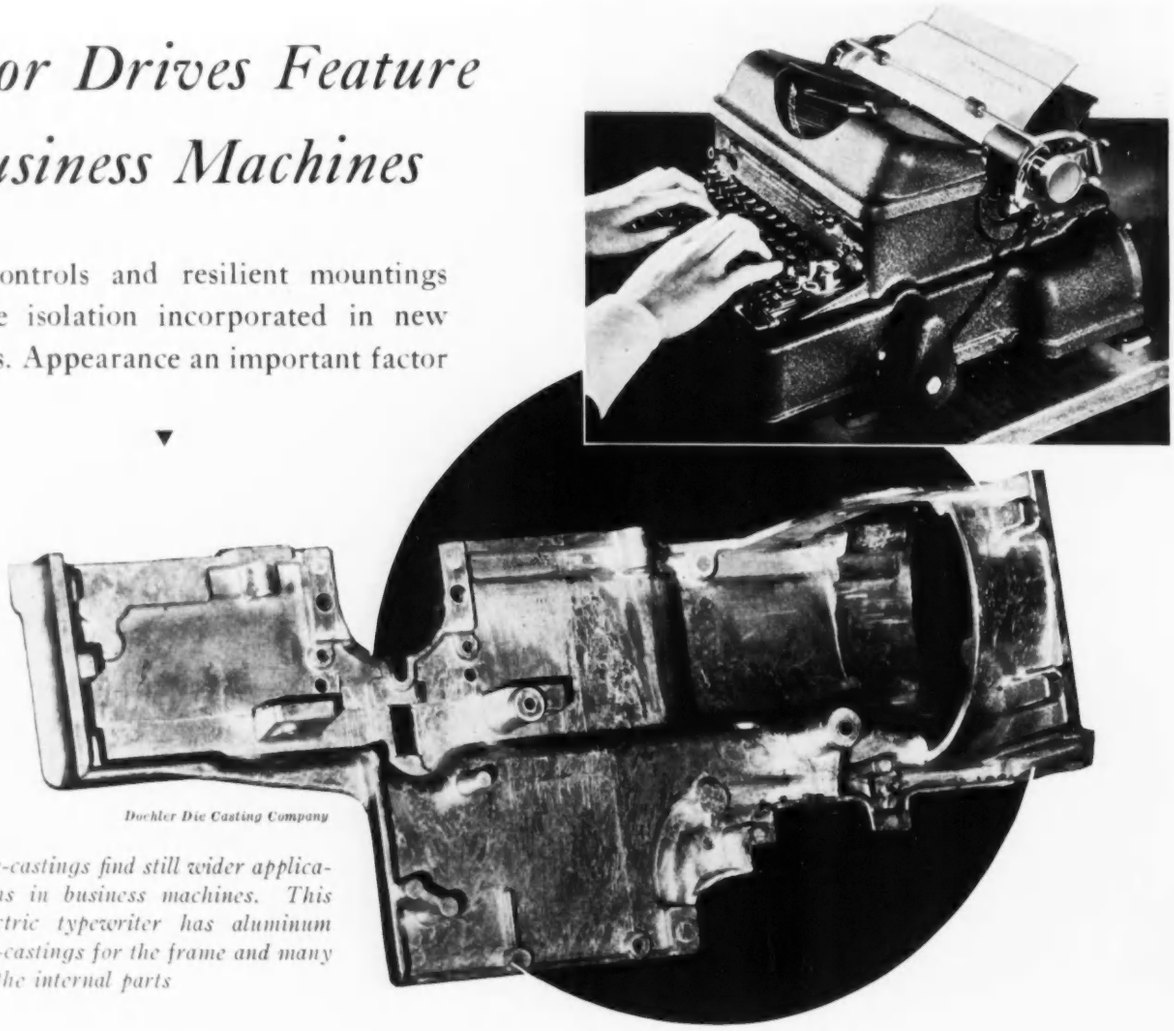


Duchler Die Casting Company

Die-castings find still wider applications in business machines. This electric typewriter has aluminum die-castings for the frame and many of the internal parts

THIS group of 16 reporting companies includes manufacturers of cash registers, taximeters, counters, oil registers, adding machines, tabulating and calculating machines, numbering machines, addressing machines, typewriters, scales, postage meter machines and motion picture equipment.

The number of employees was 259 for 1934, 281 for 1935; this year showing an 8 per cent increase over last year.

General design trends as shown in the bar chart are higher efficiency 80 per cent, appearance 94 per cent, better controls 60 per cent, less noise 53 per cent. Under types of construction, zinc die castings still show a relatively high percentage, 47, in spite of the fact that this development has been going on for several years. The electrically-operated typewriter shown here is built almost entirely of die-castings, the die-casting shown in the insert forming the right-hand side of the base. A similar casting forms the left-hand side, and other die-castings are used in the mechanism and in other parts of the frame.

As compared with household equipment and auto-

motive equipment, stamping rate relatively low, being 67 per cent. This is only a little ahead of the adoption of extruded sections indicated by 60 per cent of the designers. Plastics are being more extensively used by 53 per cent.

Among the parts and units indicated for more extended applications, is the increased use of thread-forming screws, 42 per cent; both drive and self tapping screws. An equal number of designers are extending the use of hollow-head set screws, ball bearings, fiber gears.

Greater attention is being given to motor drives, geared motors, resilient mountings and flexible couplings. More than 40 per cent of the designers indicate more attention to resilient motor mountings to reduce noise and isolate vibration.

Electrical operation of business machines has required more attention to electrical control as evidenced by the 35 per cent figure. Counters and recording instruments of various types are receiving more attention from 60 per cent of the designers.

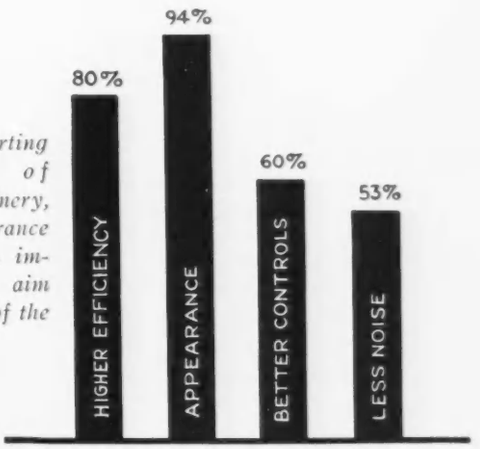
Under materials of construction, stainless steel is rated first, now being adopted or contemplated by 70 per cent primarily for better appearance. For high strength and wear resistance, 46 per cent of the designers are adopting alloy steels. Aluminum alloys are being used more extensively by 40 per cent, and 25 per cent of the designers are making a wider use of rubber to reduce noise.

In finishes, 50 per cent indicate more extensive use of lacquer, and 43 per cent for baked coatings. Among the plated finishes, cadmium is given outstanding preference by 65 per cent, while chromium is indicated by 45 per cent.

Most of the driving motors for business machines are designed so that they run only when the machine operates. The previous method of using a continuous running motor and obtaining operation by a clutch has almost entirely disappeared. This development has resulted from the availability of rapid starting motors with long small-diameter rotors for low inertia. Motor comes up to speed in a fraction of a revolution, the speed being limited by a form of centrifugal governor controlling the motor current.

One new model calculating machine has an intricate set of clutches, gear drives and reversing drives all operated electrically. The motor runs in only one direction, and the operations required are obtained from small clutches, some engaged electrically, and others engaged mechanically. These machines operate at more than ten times the speed obtainable in earlier models that were powered by a continuous running motor.

Another recent development in business machines is the use of copper brazing in a controlled atmosphere. One company reports this is making substantial savings in production and service costs while increasing the strength, quality and life of parts formerly assembled by riveting, welding and torch brazing. Parts are press fitted together, or spotted in position and rigidly attached by the brazing process that takes place in the controlled atmosphere. For example, a drive shaft handle previously spot-welded and torch brazed is now press-fitted into position and brazed. The vibration



Among the reporting manufacturers of business machinery, improved appearance is rated as an important design aim by 94 per cent of the designers

New fields of use for accounting machines are made possible as the result of the increased electrical operation of such machines. An example is this alphabetic accounting machine made by International Business Machines

and shock that this part has to withstand in everyday service are successfully met by this electric furnace brazed assembly.

One new figuring machine developed during the past year has a Durez case that eliminates nine production operations necessary in making the case of metal. The case requires no finish, no hand fittings, and the trade mark is applied permanently in the molding operations. The case also deadens noise in the mechanism and reduces weight in addition to providing an attractive appearance with smooth surfaces and rounded corners.

▼ ▼ ▼

Instrument Designers Lead Way in Using Expensive Metals

THIS section includes 13 manufacturers of instruments and sensitive devices, 16 manufacturers of control equipment, and 4 manufacturers of optical devices. Equipment included in these groups are electric motor controls, signaling equipment, thermostatic controls, accessories for gas-burning appliances, sensitive testing machines, scientific instruments, meters, electrical instruments, humidistats, controlling instruments, pressure regulating instruments, fuel level and pressure gages and flowmeters.

An unusually high increase in the number of employees in the past year is reported—39 per cent.

Under design trends there is nothing significant in either of these groups, except for the unanimous vote for appearance in the control device section. Taking the two groups as a whole, greater use of stampings is indicated by 68 per cent, plastics 60 per cent, aluminum die-casting 32 per cent, and zinc die-casting 28 per cent. These are all more or less normal or expected trends, although it should be noted that stampings in this section has but little lead over plastics. In fact, in the control device group alone, these two types of construction are given equal consideration.

Requirements of sensitivity, permanency of adjustment and accuracy have led to extensive use of beryllium copper, stainless and aluminum. Molded plastic cases, light and corrosion resistant, becoming popular.

Surface finish, electrical properties and resistance to corrosion in molded plastics place this type of construction in first position in the design of precision devices

Reynolds Molded Plastics

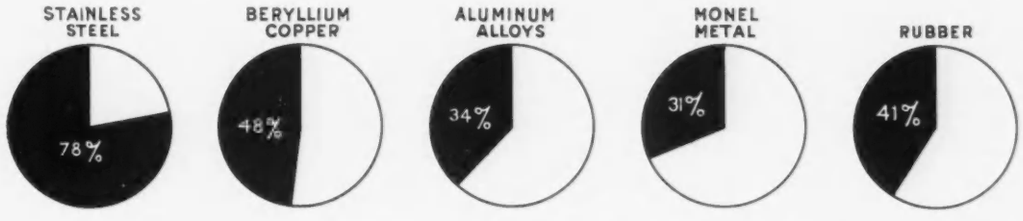
Under materials, 78 per cent of the designers indicate extended applications for stainless steel with each checking the reason as corrosion resistance. Another significant figure is the 48 per cent response on beryllium copper with the greatest emphasis placed on fatigue or impact strength. This division in the survey attaches greatest importance to beryllium copper. The use of rubber for vibration dampening was mentioned by a total of 41 per cent of the designers.

In most groups of this division the finish receiving most attention is cadmium plating, as reported by 80 per cent of the designers of control devices and more than 60 per cent of the instrument designers. Second on the list comes chromium plating, favored somewhat more by instrument designers than by the control device engineers. Two designers are extending the use of anodic coatings principally for resistance to atmospheric corrosion. For the same reasons, chemical rustproofing is being applied by three designers.

Principal design requirements in instruments and control devices are greater accuracy, more uniform response, and, in many instances, a relatively long life without adjustments or repairs. Hence, higher quality and more expensive materials find greater applications in this field. Because of the absence of periodic servicing, parts must be protected from atmospheric corrosion as well as possible. Since speed of operation of many instruments and most control devices depends upon the weight of moving parts, light-weight materials, such as aluminum alloys, find extensive application. However, magnesium alloys do not seem to have been as widely adopted as might be expected.

Ford Motor Company

In the engineering laboratories of industry, the importance of instruments and control devices calls for the utmost in reliability, accuracy and resistance to atmospheric corrosion



Materials finding extended use in instruments and control devices, and per cent of companies adopting them

Interesting applications of materials include the use of beryllium-copper clips instead of phosphor bronze, since the beryllium copper retains spring properties at temperatures in excess of 400 deg. F. Economy, strength and corrosion resistance are the reasons given for the adoption of Durez molded cases for aircraft instruments. Kollsman instruments also have molded plastic cases.

According to the Allen-Bradley Company, operations which formerly were controlled by hand are now being controlled more efficiently by automatic electric switching apparatus. This trend has made increased demands upon electrical control equipment and required dependable performance. The trend toward individual motor control in multi-motoring on machines has also made compactness an important item in motor starter design. Double-break, silver-alloy contacts and improved arcing chambers have been instrumental in increasing the capacity of starting switches and decreasing the size.

As reported by Struthers-Dunn, Inc., relay designs have been developed to meet the greater application of automatic control to the complete function of a machine

or process. For example, the proper time delay for complete process can be accomplished through relay controls, eliminating all human elements. Such relays must be compact and must operate for long lengths of time without attention.

Julien P. Frieze reports that in their own line of instruments, improved appearance of instrument cases has been a major problem. Improved finish resisting acids, alkali, scratches, heat, cold has been obtained through the use of anodic alumilite process. Two or more control instruments are combined and interconnected to provide control in terms of two ore more variables. Improved sensitivity, accuracy and reliability of portable recorders as the result of minor refinements. Locking features are now provided for adjustments on thermostats for public buildings.

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Chemical science and modern metallurgy produce a constant flow of new materials and new processes for the designer to convert into profitable products

Steyer Steel Castings Company

Summary of Data

EACH of the nine preceding sections is a summary of a large group of individual replies giving representative data for the industry. No attempt has been made to summarize the replies from smaller groups, including a total of 85 questionnaires. Questionnaires received from manufacturers of parts and units and accessories did not lend themselves to any form of group analysis. They did, however, reflect the trends in the design of the products with which the parts or units are used.

Increased activity in design development is reflected not only in the increased number of engineering department employees, but also by the unusually large number of new and redesigned products. Many engineers reported the extensive redesign of their entire lines of products. Such redesign activity has been high in every group.

Much of this redesign has been to obtain better appearance. In the design of machine tools, conveying equipment, pumps and compressors, appearance ranks second only to increased efficiency as a design aim; while in transportation, household and business equipment, in instruments and in the unclassified group, appearance seems to be the most important aim.

Taking the whole summary, stampings still rank first among the types of construction being expanded, ranking highest in the design of household and business machines. However, fusion welding is being given preference in machine tools, production equipment, construction machinery and food processing machines, while plastics rank first in the group including instruments and control devices.

Among the parts and units finding extended application, anti-friction bearings is outstanding, bearing seals and pressure lubrication are also emphasized. Hollow-head screws show a high total of extended adoptions reflecting the desire for improved appearance, particularly in the design of machine tools, production and food equipment, pumps, compressors and the miscellaneous groups. Thread-forming screws and thread-locking devices also show increased adoptions in these groups.

Preference in power drives is being given to V-belts generally, while variable speed drives and geared motors are receiving more attention in all classifications in which a power drive is an essential element. Flexible couplings and resilient motor mountings show increased adoption in all divisions.

The following tabulation gives the totals for all of the 425 companies with respect to the numbers reporting extended use of the items indicated.

In designing for better controls and in increased performance, extensive adoptions are recorded for magnetic controls, limit switches, thermostatic devices, hydraulic units and indicating instruments. Extended use of these units is reported in nearly every group.

UNITS PARTS USED MORE EXTENSIVELY

Based on 425 Companies

	Number of Companies
Ball or roller bearings	238
with integral seals	178
with separate seals	122
Sleeve bearings	40
with seals	35
Oilless bearings	122
Pressure lubrication	127
Central lubricators	77
Oil filters	86
Flexible tubing	92
Hollow-head screws	154
Self-tapping screws	102
Thread-locking devices	94
Speed reducers	94
Geared motors	126
Variable-speed drives	122
Chain drives	86
V-belts	162
Short-center flat belts	35
Flexible shafting	29
Flexible couplings	104
Magnetic clutches	39
Fiber gears	83
Metallic gears	90
Resilient motor mountings	74
Multi-motor drives	70
Motor-reducer units	67
Magnetic controls	111
Limit switches	110
Electronic controls	57
Thermostatic devices	104
Units for hydraulic operation	88
Electrically operated valves	83
Timers	57
Counters	60
Recording instruments	72
Indicating instruments	84
Built-in lighting	66

MATERIALS USED MORE EXTENSIVELY

Based on 425 Companies

	Number of Companies
Low-alloy Steels	60
Stainless Steels	188
High Strength Steels	181
Nitralloy	60
Alloy Cast Iron	161
Copper	27
Nickel	35
Cu-Ni Alloys (Monel)	61
Brass	34
Bronze	47
Beryllium Copper	33
Aluminum Alloys	129
Magnesium Alloys (Dow Metal)	36
Clad Sheets	39
Laminated Metals	9
Hard Facing Materials	48
Laminated Plastics	24
Vulcanized Fiber	22
Rubber	83
Cork	34
Felt	27
Leather	17
Plywood	16
Rare Metals	6

Taking the survey as a whole, the three finishes finding the highest number of adoptions are chromium plate, cadmium plate and lacquer. These three are outstanding in every group with cadmium showing higher percentages in several. Porcelain enamel also ranks high in household equipment. Alumilite coatings are finding increased use in transportation and household equipment and in instruments and control devices, where chemical rustproofing is also finding extended applications.

Manufacturers and users of production machinery are almost unanimous in the stand that highly efficient production machinery is essential for the prosperity of their business. Competition forces the general use of modern equipment for reducing production costs. At the same time, merchandisers are almost unanimous in reporting a rapid return to the demand for quality products. From this it can be concluded that savings from decreased factory costs will be spent in added refinements in the products manufactured. Thus, the success of the product depends more and more on the ability of the designer to select the purchased parts and materials that will contribute most to the performance, utility appearance and salability of the product.

TYPES OF CONSTRUCTION BEING USED MORE EXTENSIVELY

Based on 425 Companies

	Number of Companies
Stampings	136
Molded Plastics	78
Molded Rubber	46
Die-Castings:	
Aluminum	67
Zinc	61
Bronze	41
Drawn or Extruded Shapes	86
Resistance Welding	93
Fusion Welding	109

Republic Steel Corporation

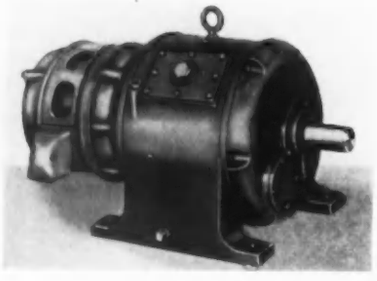
Modern machines and perfected processes in industry today are attuned to designers' desires. And many designers, as shown in the preceding pages, are awake to these profit possibilities

New Materials and Parts

Gear Motors

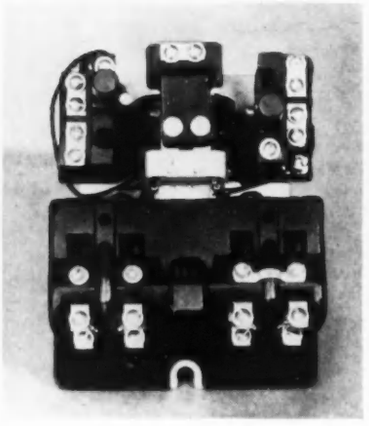
Have either helical or worm gear drives, in both the direct connected and coupled types. Single, double or triple reductions for horizontal, vertical or right angle drives are available. The motors of the double and triple reduction units are supported on the gear case. The helical gear type is equipped with heat-treated chrome nickel steel gears running on oversize anti-friction bearings. The efficiency of the double reduction type is said to be 96 per cent; for the triple reduction 94 per cent. The helical gear type is adapted to drives requiring $\frac{3}{4}$ to 75 hp. motors with speeds down to 6 r.p.m. of the driven shaft, when used with a 1,750 r.p.m. motor.

The worm gear motors are said to be 95 per cent efficient at low ratios. The worms, integral with the shafts, are made of high carbon alloy steel, carburized, hardened, ground and polished. The worm gears are made of chill-cast bronze and the shafts of chrome nickel steel. Shafts are mounted on anti-friction bearings. The worm gear type is available in power capacities of $\frac{3}{4}$ to 40 hp. with speeds on the low shaft down to 30 r.p.m. when equipped with a 1,750 r.p.m. motor. Diehl Mfg. Co., Elizabethport, N. J.



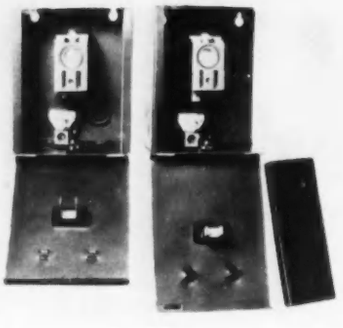
Contactors for Built-In Applications

For machine tools. The de-ion principle of arc interruption is used in these 15 and 25 amp. contactors. Confinement of arc within de-ionizing chamber is said to permit compact design desirable for built-in applications. Shock-proof vertical lift solenoid prevents closing from tilting, sudden jolts or bumping. Claimed that quenching members give high-interruption capacities, a long contact life for frequent operation and large safety factor on overloads. Contactors are self-contained, mounted on steel base with all parts accessible from the front. Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.



Ganging Type Switch

Has removable side walls, secured by screws. When used in multiple, the side walls are removed and a connector is inserted in place of the wall and are said not to take up extra room. The switch is disconnected when the door is opened so that the fuses are dead when accessible. A metal trim covers wiring and connections. Available in 3-pole arrangements: 2 and 3-wire solid neutral and straight 2-pole. Square D Co., Detroit, Mich.

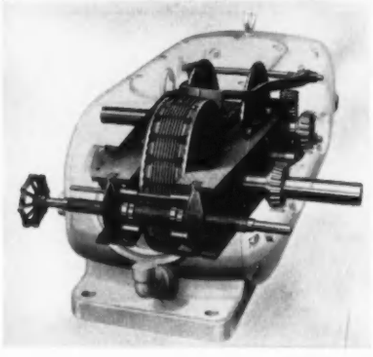


Stroboscope

This stroboscope is used for determining and checking r.p.m. of shafts and spindles where it is difficult to make contact at the ends of the shafts, or when the mechanism is too delicate to drive a tachometer. All parts are contained within one case with a direct-reading and illuminated scale for r.p.m. Provisions are made for control at line frequency or by an external contactor for same use as other stroboscopes. Has a speed range of 600 to 4,000 r.p.m., and 2,400 to 16,000 r.p.m. with an accuracy said to be plus or minus 2 per cent. Operates on a.c., 115-volt, 60-cycles and requires power of 25 watts. The instrument weighs 12 lb. Case dimensions are 6½x9x10 in. high. General Radio Co., 30 State St., Cambridge A., Mass.

Motorized Variable Speed Transmission

New design features have been added to the P.I.V. variable speed transmissions which were previously available only with horizontal boxes up to 10 hp. These new features include (1) motorized when desired, with motor integral with unit, (2) with or without speed reduction gears, (3) either horizontal or vertical box, (4)



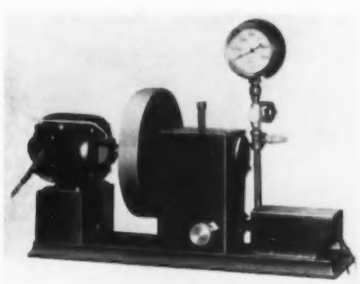
in five sizes to 15 hp. capacity. The motorized construction eliminates the use of a separate motor base plate. Illustration shows handwheel control. Remote mechanical or electrical controls are also available. Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

Brass Die-Casting Alloy

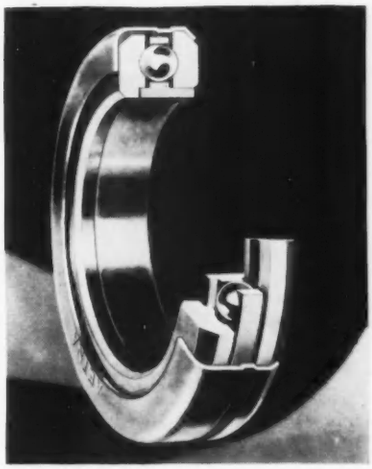
"Doler-Brass" is a new alloy containing copper, zinc and silicon, said to give a fine finish when cast. This material has a tensile strength of 65,000 to 75,000 lb. per sq.in. Its elongation is from 20 to 25 per cent in 2 in. A Brinell hardness of 110 to 120 (500 kg.) is obtained. The impact strength is 30 to 36 ft.lb. The metal has a light yellow color. Doehler Die Casting Co., 386 Fourth Ave., New York, N. Y.

Hydraulic Pump

Is driven by a motor directly connected to a crankshaft and flywheel, driving four pistons 90 deg. apart and two spool valves 180 deg. apart. Pistons and valves are sealed with piston rings. Normally the fluid is circulated through an idling valve. When this valve is in working position, the fluid is conducted through another spool valve with two outlets. This valve is controlled from a pressure-regulation valve which moves automatically when the fluid reaches a pre-determined pressure, and conducts the fluid



through a second outlet. Likewise when the pressure in this outlet reaches a pre-determined level, the idling valve is automatically moved to the idling position. By the use of a flywheel, it is claimed that the hydraulic cylinders can be operated at the same speed and economy as crank presses. Illustration shows a pump of 5.6 gal. per min. capacity, having $\frac{3}{4}$ in. diameter pistons and $\frac{3}{4}$ in. stroke, capable of 5,000 lb. working pressure. A $\frac{1}{3}$ hp. motor drives the pump. Hydro-Motive Co., 1015 W. Washington Blvd., Chicago, Ill.

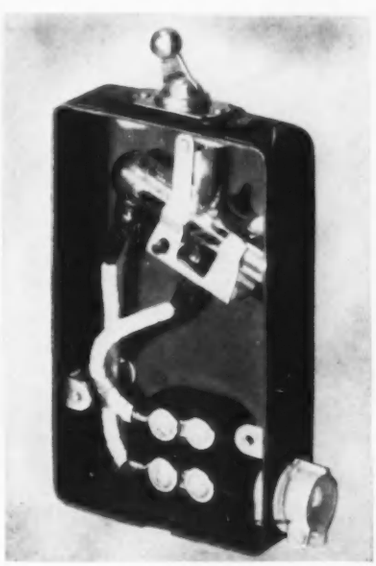


Clutch Release Bearing

Type T bearing for heavy loads is self-lubricating and does not require further attention, as the bronze ball retainer is impregnated with oil. It is said that eccentric throw and consequent wear are eliminated because of the construction and assembly of the ball retainer. Aetna Ball Bearing Mfg. Co., 7310 Woodward Ave., Detroit, Mich.

Mercury Tube Toggle Switch

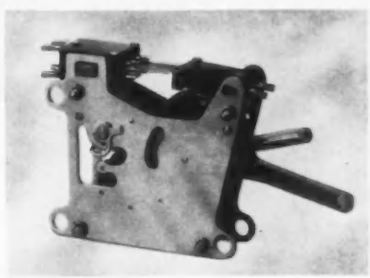
Small switch is operated by a noiseless toggle which tips a sealed mercury tube, making and breaking the circuit by the flow of mercury. By this method, positive contact is always assured, no exposed arc is possible and sticking or corroding contacts are avoided. For use in any location where exposed arcing would be dangerous. Mounted in a black enameled steel



case, $4\frac{13}{32}$-in. high, $2\frac{1}{8}$-in. wide and $1\frac{3}{32}$-in. deep. Used for a.c. and d.c. circuits and has capacities of 30 amp.—125 volts and 20 amp.—250 volts. The Hart Mfg. Co., Hartford, Conn.

Double-Throw Timer

Is used for short time intervals on 2-heat appliances. Provided with two levers, one of which fixes the timing interval, the other simultaneously clos-



ing the switch and starting the timer mechanism. Timing lever is adjustable or may be permanently set. Has two silver contacts and can be set to 5 min. maximum. Timing ranges up to 9 min. can be provided. The No. 59-LA Timer is of double pole, 6 amp. capacity. Operates on 110 volts a.c. or d.c. and measures $3\frac{1}{4}$ in. overall, $2\frac{3}{8}$ in. high and 1 in. deep. Walser Automatic Timer Co., Graybar Bldg., New York, N. Y.

Thiokol C-103

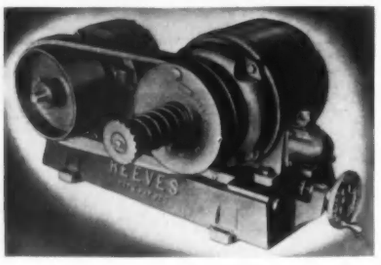
A synthetic rubber coating material that can be brushed, sprayed, dipped or spread and can be applied to cloth, cork, leather, and vegetable and animal fibers. When applied the film is said to have an elastic limit in excess of 400 per cent and to retain its flexibility to —40 deg. F. It is claimed not to deteriorate with age, to retain its luster, to be impermeable to gases, and to resist solvents and dilute solutions of acids and alkalis. Thiokol Corp., Yardville, Trenton, N. J.

Free-Machining Steels Contain Selenium

Because selenium is claimed to be superior to sulphur as a free-machining element, this alloy is being used in "screw stock." It is said that the addition of a certain percentage of selenium does not result in as much slag-like material as an equal percentage of sulphur, so that cleanness and uniformity

are increased. Being more potent, selenium is added in smaller percentages than sulphur to produce the same free-machining effect. It is further claimed that the presence of selenium does not interfere with the response to heat-treatment. The comprehensive experimental work covers many of the S.A.E. steels in both low-carburizing and higher carbon tempering grades and different types of alloy and plain carbon tool steels. The Carpenter Steel Co., Reading, Pa.

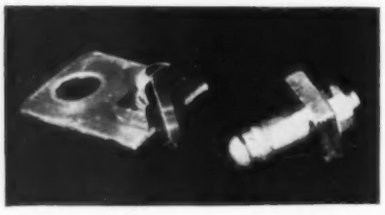
Variable-Speed Reducers



Where a large speed reduction is required a "Vari-speed Motor Pulley" is mounted on a movable slide, adjustable in a common base on which is mounted a speed reducer. The two units are connected by a belt. Any standard make of speed reducer, within the limitations of the base, can be used. This base is available in a number of sizes. Reeves Pulley Co., Columbus, Ind.

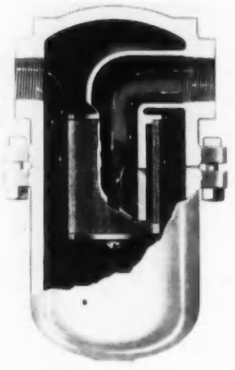
Rivet and Anchor Bolt

Used for sealing holes and cracks or for replacing rivets on air, steam, hot water or oil containers. This "multi-seal" can be applied and fastened from one side of the work and is composed of a square-head lead alloy insert, a screw, hex nut and ferrule. Is inserted into a hole, the hex nut being drawn up which spreads the ferrule and compresses the lead alloy insert. Forms a seal in the hole and on the inner and outer surfaces. Said to withstand 2,000 lb. pressure and to have a fusing point of 900 deg. F. Available in 4 sizes for $\frac{1}{4}$ to 2 in. dia. holes. Multi-Seal Mfg. Co., 7765 Sheridan Road, Chicago, Ill.



Separator

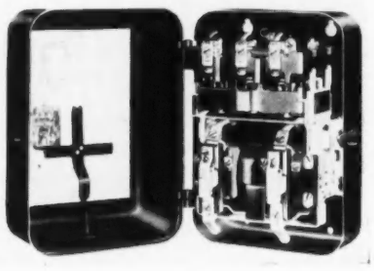
For removing water and oil from air or steam. Moisture or oil-laden vapor is zig-zagged through several layers of coarse mesh screen which produces the effect of many tiny baffles. Will withstand pressures up to 150 lb.



per sq. in. Interior parts can be removed without disturbing inlet or outlet connections. Available in sizes of $\frac{1}{8}$ to 2 in. pipe. The Johnson Corp., Three Rivers, Mich.

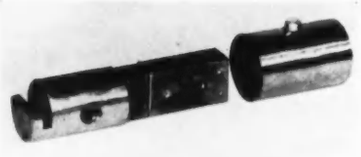
Motor Starter

Across-the-line motor starter for general purpose installations. Type A-32 has temperature overload designed on the melting alloy principle. Equipped with heavy silver contact, vertical make and break, short-stroke mechanism and multi-break arc-prevention. Inclosed in pressed steel case equipped with knock-outs. Rated at 25 hp., for 440 and 550 volts; 15 hp., at 220 volts, and $7\frac{1}{2}$ hp. at 110 volts. Is furnished for pushbutton (remote) control. Condit Electrical Mfg. Corp., Hyde Park Station, Boston, Mass.



Improved Coupling Flexpin

Is made of laminated steel, copper coated to resist rust. Laminations are retained in holder by welded keeper pins. Phosphor bronze bearing strips of large contact area, are welded to the outside spring leaves. Unit bearing pressures are reduced. Longer life is said to result by virue of bronze bearing strips, contacting case hardened steel bushing with rectangular broached hole. Flexpins retained in coupling flange by spring ring. Clutches available for $\frac{3}{4}$ to 4,200 hp. at 100 r.p.m., and $1\frac{1}{8}$ to $13\frac{1}{4}$ in. bore. Smith & Serrell, Globe Indemnity Bldg., Newark, N. J.



MANUFACTURERS' PUBLICATIONS

Air-Conditioning Equipment — The Emerson Electric Mfg. Co. Catalog X-573 and Sheet X-826, 9 pages. Furnace blowers and fans, air washers, filter housings and bonnet controls for air-conditioning and warm air heating systems.

Alloy Iron — Bethlehem Steel Co., Bethlehem, Pa. Booklet No. 54-B "Silvery Mayari Alloy Iron," 24 pages, 5x7½ in. Illustrating the use of nickel chromium iron with high silicon and low carbon content for castings. Chemical analyses of various grades are given and tests show uniform hardness obtained.

Automatic Motor Starters—The Lincoln Electric Co., Cleveland, Ohio. Two circulars describing Types XLA across-the-line starters for 3 and 5 hp., and Type XLB and XLBB across-the-line starters for $7\frac{1}{2}$ to 30 hp. Standard design features are listed.

Condor V-Belts—Facts on Construction—Raybestos-Manhattan, Inc., Passaic, N. J. Bulletin No. 6840, 4 pages, 8½x11 in., explains details of constructions and illustrates technical data on whip-cord V-belts. Bulletin No. 6808-B shows applications and hp. ratings.

Elastic Stop Nuts—Elastic Stop Nut Corp., Elizabeth, N. J. Catalog A-43, 13 pages, 8½x11 in. Design information on the use of safety nuts with photographs of numerous applications to aircraft, railway cars, automobiles, engines and machinery. A list of sizes and types of various materials is included.

Field Rheostats — Ward Leonard Electric Co., Mount Vernon, N. Y. Bulletin 60-A, 16 pages, 8x10½ in. Illustrates and describes 6, 8 and 13 in. diameter "Vitrohm" pressed steel plate rheostats. Mounting diagrams and dimensions given for switchboard, concentric and floor mountings.

Koroseal—The B. F. Goodrich Co., Akron, Ohio. Booklet No. 1050, 12 pages, 6x9 in. Description of a new material of synthetic rubber-like material made in a variety of compounds ranging from bone-like hardness to a liquid. Physical properties, resistance to various materials and influences and several test charts are given. Numerous uses and forms in which it is available are listed.

Laminated Bakelite—Synthane Corp., Oaks, Pa. Folder on paper and fabric impregnated with bakelite resinoid. Physical, electrical, chemical and mechanical properties and a list of various uses are given for sheets, rods, tubes and special shapes in numerous colors. One section deals with silent gears.

Lubrication of Bearings in Electrical Machinery—The Imperial Electric Co., Akron, Ohio. Single sheet, 8½x11 in., contains data on the care of ball bearings, pointers on sleeve bearings and types of lubricants used. "Ten Ball Bearing Commandments" explain the "do's and dont's" on proper bearing maintenance for electrical apparatus. Cross section drawings show proper design features.

Motors—General Electric Co., Schenectady, N. Y. Bulletin GEA-246D, 4 pages, 8x10½ in. Describing high-speed synchronous motors for 2 and 3 phase up to 600 hp. Photographs explain the detailed construction features. Various types and mountings are also shown.

Permite Bronze—Joseph T. Ryerson & Son, Inc., 16th & Rockwell St., Chicago, Ill. Leaded phosphor bronze bars 6 ft. lengths for automatic screw machine use. Chemical properties are given and physical properties are shown in graph form. Case histories are included.

Rheostats and Resistance Units — Ohmite Mfg. Co., 636 N. Albany Ave., Chicago, Ill. Catalog 14, 11 pages, 8½x11 in. Various types of rheostats, resistors, switches, chokes and attenuators for industrial, radio and electronic fields.

Time Switches — General Electric Co., Schenectady, N. Y. Bulletin GEA-1427D, 8 pages, 8x10½ in. Types T-17 and T-27 general purpose automatic time switches, timed and powered by Telechron motor.

Transmission Appliances—SKF Industries, Inc., Front St. & Erie Ave., Philadelphia, Pa. Bulletin 224-50S, 30 pages, 8½x11 in. Ball and roller pillow blocks, flanged housings, take-up boxes and hangers listed with capacities and dimensioned outlines. Dimensional and load data for numerous sizes of ball and roller bearings also given.

BOOKS AND BULLETINS

Principles of Metallography

R. S. Williams and *V. O. Homerberg*. 306 pages, 5½x8 in. 302 illustrations. Green cloth bound covers. Published by McGraw-Hill Book Co., Inc., 330 West 42d St., New York, N. Y. Price $3.50.

In this third edition important additions have been made throughout the textbook to bring it up-to-date with latest developments, both in physical metallurgy and equipment used for examining the structure of metals. As in earlier editions, the first two chapters are devoted to the construction and interpretation of constitutional diagrams.

Chapters on iron and steel and nonferrous alloys include extensive data on the structure and properties of such materials as stainless steel, age hardened copper and aluminum alloys, and corrosion resistant films. The closing chapter on laboratory methods illustrates and describes latest types of equipment for microscopic examination, magnetic testing, and X-rays.

Three Monographs on Color

Prepared and published by the Research Laboratories of the International Printing Ink Co., 75 Varick St., New York, N. Y. Three books, 70 pages total, 8½x11 in. Board covers. Price $10.

As with any satisfactory text on the subject of color, extensive use of illustrations increases the cost of printing. In this series of three short monographs, color illustrations are used profusely, and form an important feature. Incidental illustrations as well as reference matter in full color add greatly to the effectiveness of the text.

The first book, "Color Chemistry," outlines the development of synthetic color compounds with only sufficient detail to demonstrate the importance of specialized chemical control, giving the designer a glimpse of the highly technical nature of present-day color manufacture.

In the second book, "Color as Light," the outstanding page is a full color reproduction of the spectrum printed with a scale of color wavelengths. Refractive indices, selective absorption, measurement of color, matching of colors and importance of particle size are effectively presented in text, tables and illustrations. This book is written in such a way as to appeal specifically to engineering designers.

"Color in Use," the third book, will give the engineer a better insight into the mental processes and design procedure followed by color specialists. Three dimensions of color, color relationship, and rules for color balance are defined and profusely illustrated in color. The last part of the book includes 40 examples of color designs, each accompanied by a brief discussion.

These three short texts will give any designer a better knowledge of how colors are made, how they are specified, and how to use good taste in applying color to any product. The text material is concise and clear, bearing evidence of the collective effort of several collaborators.

Practical Solution of Torsional Vibration Problems

W. Ker Wilson. 438 pages. 5½x8½ in. 106 illustrations. Clothboard covers. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $7.

As the title indicates, the book is a practical reference source on torsional problems, particularly of the type found in internal combustion engines. The first three chapters include calculations of natural frequencies, using simple approximate methods adaptable to ordinary design work.

Chapter 4 presents a method for finding stresses at speeds other than the natural frequency. The effect of damping compounds and stresses at resonance for systems of several masses are handled in a practical manner in succeeding chapters.

Methods of measuring torsional vibrations, descriptions of torsiographs, and the interpretation of instrument records are included with sufficient detail for most design work, and a similar treatment is given damping devices and flexible couplings. Direct-coupled engine-driven electrical generating sets are discussed in the closing chapter.

Elements of Motor Vehicle Design

C. T. B. Donkin. 289 pages, 5½x8½ in. 90 illustrations. Blue clothboard covers. Published by Oxford University Press, 114 Fifth Ave., New York, N. Y. Price $4.25.

This book is primarily intended for designers, draftsmen, and students in motor vehicle design who have a knowledge of mechanics and practical

mathematics, exclusive of calculus. Several sections of this second edition have been rewritten and obsolete matter has been discarded. The chapters on gearing and brakes have been brought up-to-date to conform to current practice. A considerable portion of explanatory matter has been added where it was shown to be necessary. Several graphs in the chapter on steering gear are new and original.

The book is divided into 19 chapters, embracing construction, materials, thermodynamics, horsepower and efficiency, tractive effort and power, gas engine details, valve timing and cam profiles, carburetion and ignition, clutches, gearing and gear boxes, drive shafts and universal joints, front and rear axles, steering gear, brakes, frames and springs, radiators and pumps. The various chapters have numerous problems with answers given. Both assembly and diagrammatical drawings and graphs and charts illustrate the theories and practices pertaining to motor vehicle design.

Corrosion—Causes and Prevention

Frank N. Speller. 694 pages, 6x9 in. 141 illustrations, 87 tables. Brown clothboard covers. Published by the McGraw-Hill Book Co., Inc., 330 West 42d St., New York, N. Y. Price $7.

The subject matter of this book has been written with particular reference to the ferrous metals. This second edition contains new and better experimental data selected from more than 3,000 articles, written since the first edition in 1926. Because the electrochemical theory of corrosion in the presence of water is now generally accepted, Chapter 2 discusses the mechanism of corrosion in detail. As much has been learned in the past eight years about soil corrosion and protective coatings for use underground, most of Chapter 14 was rewritten. Other chapters were also partially revised.

Part I on the general principles of corrosion has 7 chapters which discuss influence of methods of manufacture and treatment, influence of factors internal and external to the metal, principles and methods of corrosion testing and the relative corrosion of ferrous metals. Part II with 8 chapters contains practical applications of corrosion preventive measures to iron and steel with attention given to the economics of the subject. This chapter discusses prevention of corrosion to atmosphere, under water, in inclosed water systems by removal of dissolved gases, in high-pressure steam plants, in hot-water heating systems, in chemical industries and underground. Stray-current electrolysis is also explained. An extensive appendix and selected bibliography of 44 pages and a 37-page author and subject index completes the book.

Mechanics of Materials

S. G. George and *E. W. Rettger.* 483 pages, 6x9 in. 428 illustrations. Blue clothboard covers. Published by the McGraw-Hill Book Co., Inc., 330 West 42d St., New York, N. Y. Price $3.75.

A complete treatment of the essential topics of mechanics of materials in which an elementary knowledge of calculus is required. In the chapter concerning the design of members, the modern methods of analysis and of treatment have been used, especially for beams, columns and members subjected to combined bending and column action.

The book is divided into 12 chapters containing text, data and examples on stresses and strains, testing materials, tension and compression, riveted joints, torsion, simple beams, shear and moment, stresses in beams, elastic curve, stress intensities on different planes, columns, nonprismatic and special beams, and slope and deflection, moment area method and theorem of three moments. An appendix and index of 21 pages completes the book.

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Nickel Cast Iron Data

The International Nickel Co., Inc., 67 Wall St., New York, N. Y. Section 1, No. 5, 12 pages, 8½x11 in. Paper covers.

"Properties of Nickel Alloy Cast Irons and their Special Applications in Petroleum Production Equipment," tells of the effect of nickel on machinability, chill depth, wear resistance, increased strength, heat-treatment, impact strength and heat-resistance of gray iron. In 14 charts and photographs are given heat-treatments, microstructures, drawing temperatures and Brinell hardnesses. The 10 tables contain chemical and physical characteristics in detail. Typical applications for 40 various parts include cylinders, pistons and rings, pump bodies, cams, gears, bushings, tables, brake and hoist drums and molds.

Tool Steels

Crucible Steel Co. of America, 405 Lexington Ave., New York, N. Y. Section 1, 95 pages, 8½x11 in. Paper covers.

A comprehensive data book on the subject of tool steels of particular value to tool designers, also containing much information for the machine tool designer. Under the section "Guide for the Selection of a Tool Steel," more than 200 applications are given with a first, second and third choice of steel grades. Analyses and heat-treatments are given for high-speed and alloy tool steels used for all types of cutting tools, punches and dies, mandrels, forming rolls, pneumatic tools and wrenches. Among the applications of interest to the machine designer are steels for bushings, clutch dogs, collets, gages, spindles and hard wearing surfaces. General working instructions for tool steels include data on forging, normalizing, annealing, hardening, tempering and grinding. Case depths, case and core hardnesses, response to hardening and quenching temperatures and time are given. Gage sizes for drill rods are included. A chart of carbon tool steel and suggested uses contains the carbon content of various grades and over 100 applications. The book is illustrated with many photographs.

Dilecto (Phenol Fibre)

Continental-Diamond Fibre Co., Newark, Del. Bulletin, 8½x11 in. 46 pages.

Because of the increasing use of synthetic resinous materials in industry, this booklet was compiled to acquaint engineers and designers with the properties, manufacture and uses of Dilecto. The pages contain numerous photographs of detailed applications made from sheets, tubes and rods. Standard grades, sizes, properties and colors in these forms are listed in tables. A two-page chart gives a comparison of the properties of vulcanized fiber, laminated Dilecto, molded Celeron and Vulcoid, all of which are manufactured by this company. These properties include dielectric and tensile strengths, density, thermal expansivity, effect of age, and resistance to heat, steam, humidity, solvents, oil and weak acids and alkalis. Machining qualities are also discussed. Non-metallic bearing material, lubricated with water is described. A page on Celeron silent gears in solid and spoked forms is included.

Wire Cloth

Audubon Wire Cloth Corp., Castor Ave. & Richmond St., Philadelphia, Pa. Bulletin No. 40-29, 8½x11 in., 55 pages.

The first section of this book lists and illustrates various grades of double crimped wire cloth, 1 to 120 mesh in steel, brass, bronze, copper, monel, nickel and stainless steel, including a list of standard or market grades. Extra fine mesh, plain and twilled weaves are listed from 100 to 325 mesh, also filter cloth in various meshes and weaves. Section 2 contains the coarse and heavier grades of "Vibraloy" abrasive resisting screens. In the last section various combinations of spiral-weave flexible wire cloth are shown, used for conveyor and processing belts and for washing, drying and sorting operations. Numerous pages of engineering data include a full scale wire diameter chart, comparative table of wire gages, various types of mesh, open area of mesh, weight in lb. per sq.ft., and trade designations. Conveyor belt design shows typical processing layouts.

Stress in a Rotating Disk

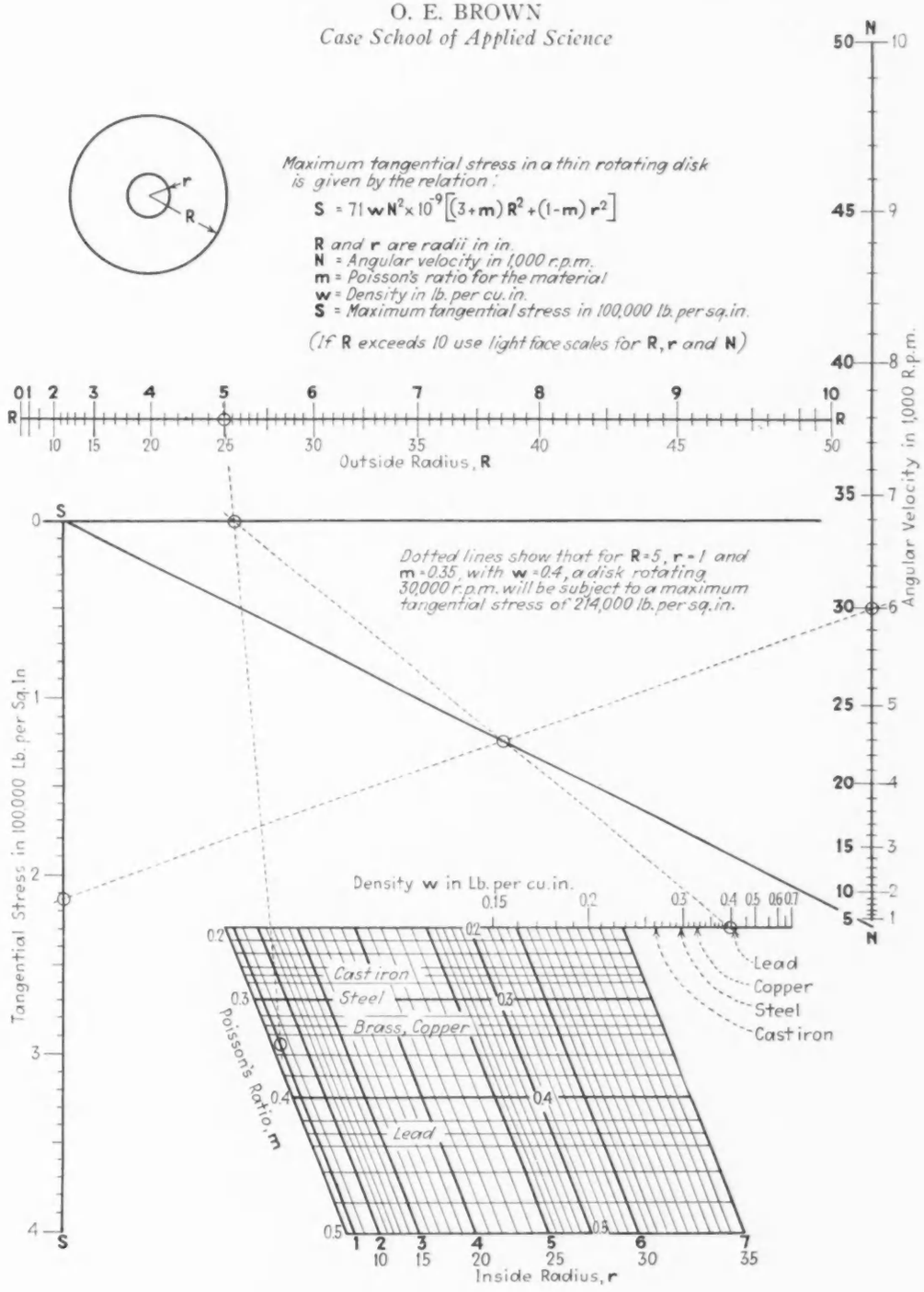
O. E. BROWN
Case School of Applied Science

Maximum tangential stress in a thin rotating disk is given by the relation:

$$S = 71\,w N^2 \times 10^{-9}\left[(3+m)R^2 + (1-m)r^2\right]$$

R and **r** are radii in in.
N = Angular velocity in 1,000 r.p.m.
m = Poisson's ratio for the material
w = Density in lb. per cu. in.
S = Maximum tangential stress in 100,000 lb. per sq. in.

(If **R** *exceeds 10 use light face scales for* **R**, **r** *and* **N**)


R
Outside Radius, R
S
Tangential Stress in 100,000 Lb. per Sq. In
Dotted lines show that for R=5, r=1 and m=0.35, with w=0.4, a disk rotating 30,000 r.p.m. will be subject to a maximum tangential stress of 214,000 lb. per sq. in.
N
Angular Velocity in 1,000 R.p.m.
Density w in Lb. per cu. in.
Cast iron
Steel
Brass, Copper
Lead
Poisson's Ratio, m
Lead
Copper
Steel
Cast iron
Inside Radius, r

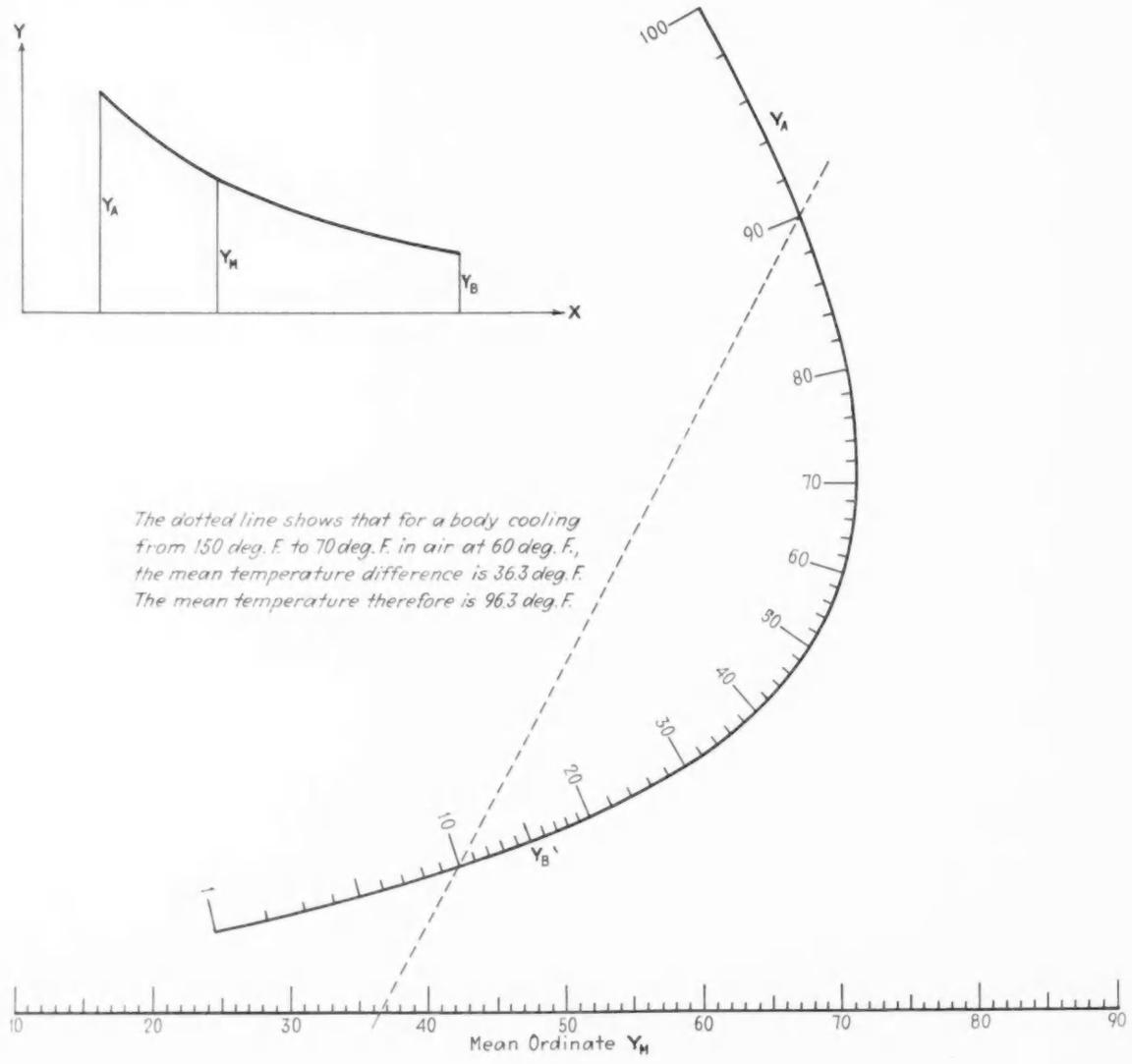
PRODUCT ENGINEERING © REFERENCE BOOK SHEET

Logarithmic Mean

O. E. BROWN
Case School of Applied Science

Where Y_A *and* Y_B *are any two ordinates to the curve* $Y = ae^{-bx}$ *the usual form of a cooling curve, the mean value* Y_M *of all the ordinates between* Y_A *and* Y_B *is given by the relation:*

$$\text{Log mean } Y_M = \frac{Y_A - Y_B}{\log Y_A - \log Y_B}$$



The dotted line shows that for a body cooling from 150 deg. F. to 70 deg. F. in air at 60 deg. F., the mean temperature difference is 36.3 deg. F. The mean temperature therefore is 96.3 deg. F.

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